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FINAL PHASE I RCRA FACILITY INVESTIGATION REPORT

FOR

BASF - WYANDOTTE FACILITY

Prepared for:

BASF Corporation
Southgate, Michigan

Prepared by:

QST Environmental
(formerly Environmental Science & Engineering, Inc.)
St. Louis, Missouri

February 26, 1999

QST Project No. 4695-010-0010

BASF

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March 4, 1999

Ms. Diane Sharrow
Project Manager
United States Environmental Protection Agency
Region V, (DRE-9J)
77 West Jackson Street
Chicago, Illinois 60604

Subject: Submittal of Final Phase I RCRA Facility Investigation Report
RCRA Facility Investigation
Docket No.: V-W-011-94
BASF Corporation, Wyandotte, Michigan

Dear Ms. Sharrow:

On behalf of BASF Corporation (BASF), QST Environmental is enclosing three copies of the Final Phase I RCRA Facility Investigation Report for the Wyandotte Facility. Mr. Ed Nuernberg, General Manager of the Wyandotte Facility, is forwarding a concurrent letter of transmittal.

The enclosed document includes:

- Report Proper;
- Appendix A: Excerpts of Geological Data and Analytical Results from Prior Investigations;
- Appendix B: Soil Boring and Monitoring Well Logs;
- Appendix C: Aquifer Testing Data and Analyses;
- Appendix D: Data Validation Reports prepared by Environmental Standards Inc. (ESI);
- Appendix E: Exposure Assumptions for Chemical Intake Estimates;
- Appendix F: Exposure and Risk Calculations; and
- Appendix G: GTI Toluene Remediation Investigation Report (TRIP), (1996).

The extensive amount of data validation reporting contained within Appendix D has been consolidated to include only those reports which were revised in ESI's Data Validation Addendum dated November 18, 1998. Similarly, no additional copies of Appendix G have been enclosed in this submittal because the TRIP Report has not been changed from the version that was included in the Draft RFI Report of December 1997.

Should you need additional information, please contact Jack Lanigan of BASF at your convenience.

Sincerely,

QST ENVIRONMENTAL INC.

Douglas F. Marian | Mark Haney/DFM

Douglas F. Marian
Project Manager

Mark Haney
Project Director

cc: Jack Lanigan - BASF
John Byrnes - BASF
Rhonda Blayer - MDEQ Lansing
L. Aubuchon - MDEQ Livonia
J. Russell - MDEQ Livonia
Barbara Wallace - Bacon Memorial Public Library

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11665 Lilburn Park Road, St. Louis, MO 63146-3535, Phone 314·567·4600, FAX 314·567·5030
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B	Soil Boring and Monitoring Well Logs (under separate cover)
C	Aquifer Testing Data and Analyses
D	Data Validation Reports (Prepared by Environmental Standards, Inc.) (under separate cover)
E	Field Parameter and Groundwater Elevation Summary Tables
F	Exposure Assumptions for Chemical Intake Estimates
G	Exposure and Risk Calculations (under separate cover)
H	GTI Toluene Remediation Investigation Report (TRIP) (under separate cover)

1.0 INTRODUCTION

This document represents the Phase I RCRA Facility Investigation (RFI) Report for Corrective Action activities completed at the BASF Corporation (BASF) North Works facility (Facility) in Wyandotte, Michigan. The Facility is located on the U.S. shore of the Detroit River at 1609 Biddle Avenue in Wayne County. The Facility location is provided in Figure 1-1.

The Facility is subject to the requirements of Corrective Action as outlined in the Administrative Order on Consent (Docket No. V-W-011-94). BASF and the U.S. Environmental Protection Agency (USEPA), Region 5, entered into the Administrative Order on Consent on February 28, 1994 pursuant to Section 3008(h) of the Resource Conservation and Recovery Act (RCRA) and the Hazardous and Solid Waste Amendments (HSWA) to RCRA.

This Phase I RFI Report (Report) has been prepared in accordance with the Administrative Order on Consent (Section VII, B.5) and the USEPA-approved RFI Phase I Work Plan dated October 1996. Further guidance, as needed, was obtained from documents including "RCRA Facility Investigation Guidance" (EPA 530/SW89-031), "Test Methods for Evaluating Solid Waste" (SW-846), and other relevant USEPA/Michigan Department of Natural Resources (MDNR) publications. This Phase I RFI Report fully complies with the Corrective Action requirements of the Administrative Order on Consent.

1.1 Purpose

This Phase I RFI Report documents the investigation activities conducted to characterize the nature (and extent for selected areas) of hazardous waste/constituent releases to the Facility from Solid Waste Management Units (SWMUs) or Areas of Concern (AOCs) as prescribed in the Quality Assurance Project Plan (QAPP). This Report will provide USEPA personnel with BASF's evaluation and conclusions regarding the Phase I RFI investigation data. Upon review and approval by USEPA, this Report will serve as a reference document and database for planning future Corrective Action activities at the Facility, as needed.

1.2 RFI Report Organization

This Report is divided into ten sections of text including eight appendices. A brief description of each section is presented below.

Section 1.0, **Introduction**, provides background information regarding the RCRA requirements for the Facility, purpose of this Report, and contents of this Report.

Section 2.0, **Facility Background Information**, references background information regarding the Facility and its environmental setting.

Section 3.0, **Summary of Preliminary Site Data**, summarizes the findings and results of previous evaluations/investigations for each SWMU/AOC under consideration.

Section 4.0, **Phase I RFI Objectives and Supporting Data Requirements**, summarizes the site-specific investigation objectives, identifies the target constituents and associated preliminary site-specific action levels (PSALs) for the Phase I RFI, and describes the established data quality objectives for the investigation.

Section 5.0, **Phase I RFI Field Activities**, summarizes the Phase I RFI field activities and describes the procedures that were utilized for all field sampling and laboratory analysis tasks.

Section 6.0, **Additional Phase I RFI Activities**, describes Phase I RFI activities including validation of the analytical laboratory data, development of a geographic information system (GIS) for the Facility, and acquisition/evaluation of pertinent existing data for sediments in the Detroit River that were not performed as part of the field investigation tasks.

Section 7.0, **Phase I RFI Results**, summarizes the geological, hydrogeological, and analytical results of the Phase I RFI.

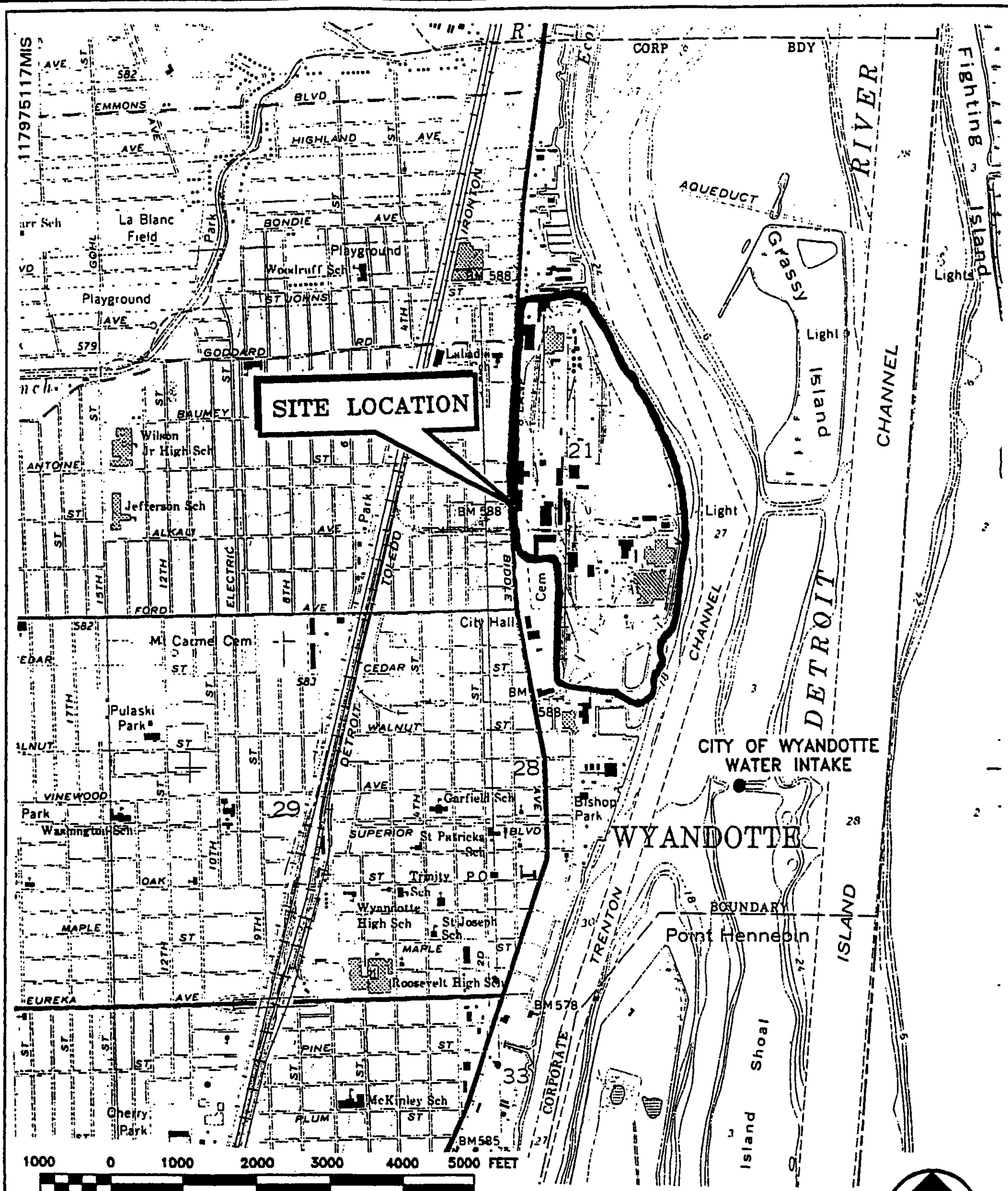
Section 8.0, **Preliminary Risk Assessment**, describes the potential exposure routes, health-based criteria, and risk associated with the site-specific constituents of concern.

Section 9.0, **Summary and Conclusions**, summarizes the Phase I RFI investigation results and presents conclusions which address the Phase I RFI objectives.

Section 10.0, **References**, provides a list of references used within the text of this Phase I RFI Report document.

Eight appendices are also provided to describe associated RFI activities. Appendices to this document are identified below.

Appendix A **Excerpts of Geological Data and Analytical Results from Prior Investigations**
Appendix B **Soil Boring and Monitoring Well Logs**
Appendix C **Aquifer Testing Data and Analyses**
Appendix D **Data Validation Reports and Analytical Laboratory Data (Prepared by Environmental Standards, Inc.)**
Appendix E **Field Parameter and Groundwater Elevation Summary Tables**
Appendix F **Exposure Assumptions for Chemical Intake Estimates**
Appendix G **Exposure and Risk Calculations**
Appendix H **GTI Toluene Remediation Investigation Report (TRIP)**



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WYANDOTTE QUADRANGLE
7.5 MINUTE SERIES, 1967
PHOTOREVISED 1981

SOURCE: WOODWARD-CLYDE CONSULTANTS

Figure 1-1
SITE LOCATION MAP

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2.0 FACILITY BACKGROUND INFORMATION

2.1 Site Description

The Facility is located within Sections 21 and 28, T. 3 S., R. 11 E. It is bounded on the west by Biddle Avenue, on the north by Perry Place, on the south by Mulberry Street, and on the east by the Detroit River (Trenton Channel). The Facility occupies approximately 230 acres.

2.2 Site History

Prior to European habitation, the majority of the eastern portion of the site consisted of marshland associated with the Detroit River. Initial site development activities began in the late 1800s with the partial drainage of marshlands and placement of fill materials.

Subsequent industrial activities at the Facility can be classified according to three primary timeframes:
1) Construction/operation of the original soda ash complex (1890s - 1920s);
2) Construction/operation of a larger, relocated soda ash complex (1920s - 1978); and
3) Construction/operation of chemical specialty plants (1978 - present).

A number of different plants were utilized at the Facility for the production of various chemical and solid products throughout this time period. Some of these plants were operated by firms other than BASF, including Detroit Soda Products Company and the Detroit City Gas Company who leased a site at the Facility. The Facility presently includes the following plants:

- Corporate Research and Development Complex (1940s-Present);
- Pilot Plant (1940s-Present);
- Polyols Plant (1957-Present);
- Chemical Engineering Research Facility (1960s-Present);
- Vitamins Complex (1970s-Present);
- Steam Facility (1981-Present);
- Elastocell Plant (1986-Present);
- Engineering Plastics Compounding (EPC) Plant (1988-Present);
- Expanded Polyolefin (EPO) Plant (1990-Present);
- Thermoplastic Polyurethane (TPU) Synthesis Plant (1991-Present); and
- Polystyrene Pilot Plant (1994-Present).

Presently, approximately 25 to 30 percent of the surface area is covered with buildings, paved streets, paved parking lots, tankfarms, and docks. Many of the aboveground structures associated with discontinued processes have been demolished, although concrete at or below grade remains. An extensive network of utilities including potable and service water lines, storm sewers, sanitary sewers, and other utilities (typical of an industrial facility) remains underground even though significant portions are no longer used, or are isolated from active lines (S.S. Papadopulos & Associates [SSP&A], 1984).

2.3 Additional Sources of Background Information

Additional detailed Facility background information has already been provided in the Current Conditions Report. For further detail regarding Facility background information, Section 2.0 of this March 1995 report should be reviewed.

3.0 SUMMARY OF PRELIMINARY SITE DATA

This section summarizes results acquired from prior site evaluations. These results assisted in the development of the investigation approach for each SWMU/AOC to attain the Phase I RFI objectives. Figure 3-1 displays the locations of the SWMUs/AOCs that were investigated in the Phase I RFI. In addition, this section of the Phase I RFI Report provides background information pertaining to the operational history and current usage for the four SWMUs and five AOCs under consideration.

In compliance with the Administrative Order on Consent for the Facility, BASF submitted the RFI Workplan (which included the Current Conditions Report) to USEPA for initial review in June, 1994. Subsequent revisions were made to various portions of the document until full approval was provided in October 1996. The Workplan provided a summary of existing Facility conditions and the proposed procedures/methodologies for the RFI activities.

As set forth in the RFI Workplan, BASF recommended that Phase I investigation activities be conducted at four SWMUs (Letters E, F, G, and H) and five AOCs (Nos. 2, 4, 5, 6, and 7). The RFI Workplan and associated QAPP were subsequently approved by USEPA in October 1996.

3.1 Preliminary Geological and Hydrogeological Characterization

3.1.1 Site Geology

A preliminary evaluation of the general site geology and hydrogeology surrounding the Facility was completed as part of the RFI Workplan to better understand the framework for migration of any potential constituent releases and the potential effects on human health and the environment. Section 3.0 of the Current Conditions Report (March 1995) should be consulted for detailed information pertaining to the general environmental setting for the Facility. Results from various site investigations (SSP&A, 1984; SSP&A, 1985; MDNR & OME, 1991; SSP&A, 1991) were also incorporated into the Current Conditions Report.

Based on the soil data acquired from prior literature evaluations and subsurface investigations (Current Conditions Report, 1995 and SSP&A, 1984), five stratigraphic units were identified beneath the Facility. These five units were classified in descending order as the 1) Fill Unit, 2) Clay and Peat Unit, 3) Native Sand Unit, 4) Lacustrine Clay Unit, and 5) Bedrock Unit.

The surface strata is comprised of industrial fill (up to 22-ft thickness). As previously described in Section 2.2, fill materials (primarily industrial residues generated on-site) were deposited on-site to fill in marshland areas and raise the entire site to its present grade. This fill varied in nature from alkaline lime waste to acidic fly ash and cinders. The fill also included some deposits of relatively clean sand and clays, metal, wood, and masonry debris. In most instances, the transition from marshland to fill is sharply defined due to visible evidence of the original vegetation from the marshland bottoms.

In general, the fill rests on peat or organic clays that evolved from the original marsh bottom deposits. Where present, the peat material occurs approximately 5-10 ft below land surface (bls) and ranges up to a 3-ft thickness depending on location.

The layers below the peat (or below the fill where the peat is absent) consist of interbedded sands and clays. Sand is prevalent beneath the western portion of the Facility, but grades into clays toward the eastern areas.

Glacial lacustrine clay underlies the sands. The clay was deposited during the latest interglacial stage when lake levels were higher than current elevations. This clay unit possesses a low permeability and effectively segregates groundwater in the fill and sand units from the water-bearing zones below.

Bedrock occurs beneath the clay unit in the form of dolomite at a depth of approximately 70 ft bls and a 150-ft thickness (SSP&A, 1984). The water contained within the dolomite possesses a high sulfur content rendering it unfit for consumption. Below the dolomite, an additional 100-ft layer of sandstone and various interbedded layers of limestone, sandstone, gypsum, and salt are present to a depth of 1,500 ft bls.

3.1.2 Site Hydrology

Based on the Current Conditions Report, surface water flow is generally to the east toward the Detroit River. BASF has completed various grading efforts at the Facility to enhance drainage and reduce runoff. In general, runoff is well-controlled on the northern half of the Facility, while a degree of runoff may occur on the undeveloped southern half of the Facility.

Small quantities of surface runoff may leave the Facility by diffuse flow to the Detroit River along the portion of the waterfront that does not possess a steel retaining wall. Similarly small quantities may also leave the Facility across the northern boundary near Perry Place. There is no discernible floodplain at the Facility. Figure 3-2 displays the locations of various shoreline improvements at the Facility.

3.1.3 Site Hydrogeology

Based on prior hydrogeologic investigations (SSP&A, 1984), the heterogeneous nature of the subsurface materials has contributed to complex groundwater flow conditions at the Facility. In addition, groundwater gradients are influenced by a variety of factors including:

- the Facility's groundwater extraction system (15 recovery wells);
- sheet piling along the Facility riverfront;
- glacial landforms;
- grading operations which have promoted internal surface water drainage patterns;
- reduced infiltration of groundwater into the Facility's storm drain systems;
- river stage;
- foundations which remain from demolished buildings; and
- old pipelines.

Groundwater is typically encountered at shallow depths ranging from approximately 3-10 ft bls within the Fill Unit. However, the clay deposits of the Glaciolacustrine Unit effectively prevent any vertical migration of this shallow groundwater into the lower aquifer units.

Groundwater is not used as a source of potable water in the Wyandotte area. The high sulfur content of groundwater in the Bedrock Unit renders it unfit for consumption.

Groundwater discharge from the Facility is restricted by the groundwater extraction system and the steel retaining wall erected along 50% of the Detroit River bank. From 1987-1996, approximately 25 million gallons of groundwater were recovered using the groundwater extraction system.

3.2 SWMU E: Polyols Pond

3.2.1 Description of SWMU and Waste Management Activities

This SWMU, also known as the Polyols Pond, is a man-made retention pond located in the northeast corner of the Facility. Figure 3-1 displays the location of SWMU E with respect to the overall layout. This SWMU is constructed of earthen dikes lined with clay and contains a concrete wall that separates the pond into two sections.

The Polyols Pond serves as a wastewater retention pond for various sources including process and stormwater from the Polyols Plant, EPO Plant, Steam facility, and non-contact cooling waters from several equipment sources. The pond also provides surge capacity in the event of any emergency upsets at the Polyols Plant.

Prior to introduction into the Pond, wastewater is neutralized as necessary with sulfuric acid. Wastewater is then combined with additional non-contact cooling water/stormwater runoff and discharged through a diffuser pipe to the Detroit River via Outfall 001. This discharge is permitted under the Facility's NPDES Permit.

SWMU E consists of an approximate 160 ft by 60 ft area.

3.2.2 Release Controls

As previously described, SWMU E includes a bottom clay liner to minimize any releases from the unit. This liner was constructed by compacting two layers of clay, each with a 1-ft thickness.

Accumulated sediment at the bottom of the pond is periodically tested, removed, and disposed at a licensed disposal facility. Analytical results from the most recent sediment removal effort indicated that the sediment materials did not qualify as a hazardous waste with respect to chemical constituent concentrations.

3.2.3 Historical Findings

There is no record or indication of any releases from the Polyols Pond. Effluent discharge concentrations for some of the parameters have exceeded NPDES permit limits on isolated occasions.

3.3 SWMU F: Filter Cake Disposal Area

3.3.1 Description of SWMU and Waste Management Activities

SWMU F is an unpaved outdoor area located in the east central portion of the Facility. Figure 3-1 displays the location of SWMU F with respect to the overall layout. The area is located to the east of Wyandotte Drive and the Vitamins Complex. This SWMU was utilized as an abovegrade disposal area for 1) spent magnesium silicate filter cake (Britesorb) and filter paper used within the Polyols Plant, and 2) soda ash, sodium bicarbonate, lime wastes, clinker, and ash from the Boilerhouse. The filter cake material is considered hazardous only by virtue of its physical potential for combustibility, not due to chemical composition. SWMU F was initially defined as an area approximately 400 ft by 250 ft.

Filter cake disposal activities were discontinued at SWMU F in 1979. At that time, approximately 60,000 yd^3 of fill had reportedly been disposed in the area to an approximate height of 8 ft above grade. SWMU F is currently maintained as an open field containing weeds and grassy vegetation.

3.3.2 Release Controls

A network of groundwater extraction wells is utilized to mitigate the migration of potentially impacted groundwater from this area. Recovered groundwater is pumped to a central carbon treatment system prior to discharge via an NPDES-permitted outfall.

In addition, ground surface contouring was performed to enhance drainage control and topsoil was added to promote vegetation growth. Topsoil has also been added to help preserve the moisture content of the material and prevent direct contact with the deposited waste materials. Combustion of the filter cake material represents a concern only when the material is present in a dried state (e.g. moisture content of material has been depleted).

3.3.3 Historical Findings

During excavation activities performed in 1990, waste filter cake material was encountered. Samples were subsequently collected for waste characterization purposes at an off-site laboratory. Analytical results indicated that the primary constituents of the filter cake were magnesium silicate and polyols. Based on the analytical results, the filter cake did not exhibit any characteristics of a RCRA hazardous waste.

3.4 SWMU G: Two Nominal Rubble Staging Areas

3.4.1 Description of SWMU and Waste Management Activities

SWMU G is an unpaved outdoor area located in the southern portion of the Facility. Figure 3-1 displays the location of SWMU G with respect to the overall layout.

The area identified as SWMU G has been built up with industrial fill from approximately 1890 through the 1980s. The Consent Order references a subsequent period when the Soda Ash Complex was dismantled and the area was used to stage rubble and debris. Concrete, steel, and other debris were piled in this area prior to removal from the Facility. Some soda ash, lime fines, and cinders may have been present as residual material in hoppers or bins, but these materials are not classified as RCRA hazardous wastes. Some rubble including bricks, concrete, and reinforcing steel has been found in the top layers of soil in the area.

SWMU G was initially defined as an area approximately 600 ft by 450 ft. SWMU G is currently maintained as an open field containing weeds and grassy vegetation.

3.4.2 Release Controls

A network of groundwater extraction wells is utilized to mitigate the migration of potentially impacted groundwater from this area. Recovered groundwater is pumped to a central carbon treatment system prior to discharge to the POTW.

In addition, ground surface contouring has been performed in the past 12 years to enhance drainage control and topsoil was added to promote vegetation growth.

3.4.3 Historical Findings

Since RCRA hazardous wastes were never stored or deposited within SWMU G as part of the demolition rubble staging activities, no previous investigations have been completed within this area.

3.5 SWMU H: Emergency Containment Pond

3.5.1 Description of SWMU and Waste Management Activities

SWMU H is located in the east central portion of the Facility. Figure 3-1 displays the location of SWMU H with respect to the overall layout. The area is located to the south of the Pilot Plant and Vitamins Complexes, north of the Engineered Plastics Complex, and east of the railroad tracks. This SWMU was historically utilized as a retention pond and drainage system which discharged to an outfall on the Detroit River (currently identified as Outfall 003). SWMU H was initially defined as including approximately 1,600 linear feet of trenching.

Origin of the drainage system dates back to the late 1800s when it was used in dewatering/filling activities for the original Detroit River marshland. Since fragmental records from the 1920s indicate that the Facility utilized only one drainage network, the system likely was utilized as a combined drainage system for stormwater, non-contact cooling water, contact wastewater, and sanitary wastestreams. SWMU H gradually evolved into the current configuration of SWMU H at which time the primary effluents consisted of stormwater, non-contact cooling water, contact wastewater from the Pilot Plant, and subsequent contact wastewater from the Chemical Engineering Building. Over the years, the Pilot Plant manufactured/handled a wide variety of materials including polyols, urethane latex, isocyanates, amines, magnesium silicate, methanol, methylene chloride, isopropyl alcohol, and Basalin (a herbicide). None of the drainage system was lined; it was periodically dredged to maintain flow.

Beginning in the early 1980s, this drainage system was gradually filled in and replaced with a steel piping system with welded joints to prevent infiltration of groundwater to the discharge at Outfall 003.

SWMU H is currently used only as the subsurface corridor for the hard-piped drainage system. The overlying areas are maintained as open field areas containing weeds and grassy vegetation.

3.5.2 Release Controls

The containment pond was equipped with entrance/discharge pipe valves to isolate spills from the Pilot Plant. Portions of the drainage system also incorporated piping to facilitate roadways over the ditches and control drainage flow. Other containment features (primarily weirs) were likely used to isolate downstream impoundments from periodic source releases, although written documentation of these events was not available. Upon the advent of USEPA's NPDES program, all sampling/discharge events associated with the open drainage system were regulated under the Facility's NPDES permit.

Currently, a network of groundwater extraction wells is utilized to mitigate the migration of potentially impacted groundwater from this area. Recovered groundwater is pumped to a central carbon treatment system prior to discharge to the POTW.

In addition, ground surface contouring was performed to enhance drainage control and topsoil was added to promote vegetation growth. Topsoil also serves to prevent direct contact with the deposited waste materials.

3.5.3 Historical Findings

No previous investigations have been completed within SWMU H. Although a Basalin spill is known to have occurred at SWMU H, there are no other records which indicate how often the unit may have been used for spill containment purposes.

In addition, AOC 5 conditions are considered relevant since western portions of SWMU H overlap with AOC 5. Propylene dichloride (PDC) spillage impacted soil and groundwater during the 1970s. BASF conducted a subsurface investigation and encountered PDC concentrations up to 10,000 ppm in soil. Elevated PDC concentrations may interfere with analytical methods used to measure low concentrations of other VOCs.

3.6 AOC 2: Old Coke Plant

3.6.1 Description of AOC and Waste Management Activities

AOC 2 is located in the east central portion of the Facility. Figure 3-1 displays the location of AOC 2 with respect to the overall layout. The area is located to the south of the Thermoplastic Polyurethane Plant, north of the Vitamins Complex, and generally east of the railroad tracks. This AOC was formerly occupied by Kopper's process coke ovens and a by-products plant which operated in this area. AOC 2 was initially defined as an area approximately 650 ft by 250 ft.

The eastern part of AOC 2 is currently used as a contractor parking area with scattered portions being maintained as open field containing weeds and grassy vegetation. The additional western portion of AOC 2 identified by aerial photographs extends into an area currently occupied by BASF trailer offices, a paved parking area, and a railyard spur.

3.6.2 Release Controls

A network of groundwater extraction wells is utilized to mitigate the migration of potentially impacted groundwater from this area. Two extraction wells, E14NC and E15NC, have been utilized in this area to collect groundwater in the vicinity of this AOC. Recovered groundwater is pumped to a central carbon treatment system prior to discharge to the POTW.

In addition, a surface drainage control program has been implemented to minimize the migration of coke-related constituents from this area. Topsoil has been added at selected locations to promote vegetation growth. Topsoil and paved areas also serve to prevent direct contact with any potential coke-related waste materials.

3.6.3 Historical Findings

During an EPA investigation in 1981, coke-related waste materials were encountered in both soil and groundwater at AOC 2. Analytical results indicated the presence of typical coking process constituents including toluene, PAHs, phenols, cyanide, and various metals.

Immediately adjacent to this area, AOC 1 is being evaluated as part of the Toluene Remediation Investigation Project (TRIP). A copy of the TRIP is provided as Appendix H to this report.

3.7 AOC 4: North Tar Pit

3.7.1 Description of AOC and Waste Management Activities

AOC 4 is located in the north central portion of the Facility. Figure 3-1 displays the location of AOC 4 with respect to the overall layout. The area is located to the immediate south of a Polyol tankfarm, east of the railroad tracks, north of Sioux Street, and west of the Thermoplastic Polyurethane Plant. This AOC was utilized prior to 1966 for disposal of coal tar by-product from the Old Coke Plant. Limestone fill has periodically been placed across this AOC to facilitate vehicle/equipment parking. However, the tar material becomes fluid during the summer months and buoyancy raises it to the surface. During these periods, the area is sometimes incapable of supporting vehicles or equipment.

AOC 4 is currently used as a contractor work area and equipment storage area.

3.7.2 Release Controls

A network of groundwater extraction wells is utilized to mitigate the migration of potentially impacted groundwater from this area. Two extraction wells, E14NC and E15NC, have been utilized in this area to collect groundwater in the vicinity of this AOC. Recovered groundwater is pumped to a central carbon treatment system prior to discharge to the POTW.

As previously described, limestone is periodically laid to enhance use of AOC 4 as a parking/storage area and also minimize direct contact with coal tar materials.

3.7.3 Historical Findings

No previous investigations have been completed within AOC 4.

However, immediately adjacent to this area, AOC 1 has been evaluated as part of the TRIP. During the TRIP, two soil borings were advanced along the eastern edge of AOC 4. Black tar (two to six-foot thickness) was encountered during the completion of these borings. BTEX and styrene were detected in a sample of the tar material.

3.8 AOC 5: Propylene Dichloride (PDC) Spill Area

3.8.1 Description of AOC and Waste Management Activities

AOC 5 is located in the central portion of the Facility. Figure 3-1 displays the location of AOC 5 with respect to the overall layout. The area is located to the south of the Pilot Plant and Vitamins Complexes, north of the Engineered Plastics Complex, and east of the railroad tracks. This AOC also overlaps with SWMU H. Propylene dichloride (PDC) releases have impacted soil and groundwater in this area. AOC 5 was defined as an area approximately 1,000 feet by 500 feet.

In the early 1960s, a salt bed cavity beneath this AOC was utilized for the injection of propylene dichloride (PDC). Although this cavity is apparently isolated from other aquifers, it is in communication with similar brine cavities beneath the Facility. As a result, not all of the injected PDC was recovered.

Prior to injection, PDC was also released during the course of railroad tank car unloading operations over the years. Spillage in the vicinity of the unloading pad subsequently spread and impacted a larger area currently identified as AOC 5. The PDC injection well was plugged in the late 1970s.

AOC 5 is currently maintained as an undeveloped area containing weeds and grassy vegetation. Only limited construction activities are allowed in this area.

3.8.2 Release Controls

In fulfilling one of the major objectives of the 1986 MDNR Consent Decree, a network of groundwater extraction wells was installed to mitigate the migration of potentially impacted groundwater from this area. Nine groundwater extraction wells have been utilized within AOC 5 to control groundwater flow in the vicinity of this area. As an additional side benefit, the system has successfully recovered approximately 21,000 gallons of PDC from the shallow water-bearing fill and soils. Recovered groundwater is pumped to a central carbon treatment system prior to discharge to the POTW.

Storm sewer improvements have also been completed within AOC 5 to control migration of PDC from the area. The entire drainage system was replaced using a steel piping system with welded joints to prevent infiltration of groundwater to the discharge at Outfall 003.

In addition, ground surface contouring has been performed to enhance drainage control and topsoil was added to promote vegetation growth.

3.8.3 Historical Findings

3.8.3.1 Constituent Characterization

MDNR studies in 1981 identified ~~the~~ presence of cresols, chloroform, benzene, PDC, phenolics, several metals, and PAHs near AOC 5.

BASF conducted a subsequent investigation in 1985 to define the nature and extent of contamination in this area. Results indicated elevated PDC concentrations in soils; levels at some locations exceeded 10,000 ppm. Elevated PDC levels were typically observed to be present in the sand layer. Other detected components of the original waste material included ethylene dichloride (EDC) and bis(2-chloroisopropyl) ether (BCIE). The analytical evaluation process also resulted in the finding that elevated PDC concentrations may interfere with analytical methods used to measure low concentrations of other VOCs.

The 1985 investigation delineated the horizontal extent of PDC in the north, south, and west directions. As a result, RFI activities were focused on delineating the eastern (downgradient) edge of this AOC.

Vertical delineation results indicated that PDC (specific gravity of 1.2) has preferentially accumulated within the sand layer of various low spots over the lacustrine clay layer. This conclusion is consistent with the findings of other investigators who have demonstrated that the movement of PDC in a saturated medium is controlled by the configuration of the lower confining unit (USEPA, 1992). Essentially, PDC has tended to migrate toward the lowest elevation "pockets" of the confining clay unit.

In addition, SWMU H conditions are considered relevant since western portions of AOC 5 overlap with SWMU H. Although a Basalin spill is known to have occurred at SWMU H, there are no other records which indicate how often the unit may have been used for spill containment purposes.

3.8.3.2 Geological/Hydrogeological Characterization

Based on previous studies, surficial materials are heterogeneous in content and transmissivity, but generally consist of industrial fill overlying interbedded sand/clay and bedrock units. Groundwater flow and PDC distribution are influenced by the heterogeneity of the surficial materials, the groundwater extraction system, and the redesigned stormwater drainage system.

3.9 AOC 6: South Tar Area

3.9.1 Description of AOC and Waste Management Activities

AOC 6 is an unpaved outdoor area located in the southern portion of the Facility. While the western portion of AOC 6 overlaps SWMU G, the majority of the area extends to the east of SWMU G. Figure 3-1 displays the location of AOC 6 with respect to the overall layout.

BASF personnel suspect that low lying areas in this vicinity were filled with coal tar waste from the Coke Plant (AOC 2). AOC 6 was initially defined as an area approximately 420 ft by 220 ft. AOC 6 is currently maintained as an open field containing weeds and grassy vegetation.

3.9.2 Release Controls

A network of groundwater extraction wells is utilized to mitigate the migration of potentially impacted groundwater from this area. Recovered groundwater is pumped to a central carbon treatment system prior to discharge to the POTW.

In addition, ground surface contouring has been performed in the past 12 years to enhance drainage control and topsoil was added to promote vegetation growth.

3.9.3 Historical Findings

During a 1981 subsurface investigation, coal tar-like constituents (VOCs, PNAs, phenols, and metals) were discovered in this area.

Impacted soils were encountered in 1992 during excavation activities to repair piping in the groundwater extraction system (between extraction wells E2NA and E3NA). Excavated soil was sampled for characterization purposes and placed into roll-off boxes. Based on the laboratory analyses, approximately 60 cubic yards of material were classified as a RCRA characteristic hazardous waste (D018-benzene) and subsequently transported off-site for incineration.

3.10 AOC 7: Prussian Blue Areas

3.10.1 Description of AOC and Waste Management Activities

AOC 7 was initially defined to include two areas in the northwest corner of the Facility. One additional area was identified in May 1997 during excavation activities for surface drainage modifications in the central portion of the Facility. Figure 3-1 displays the three AOC 7 locations with respect to the overall layout.

The first area (AOC 7A) is located to north of the Kreelon Building and west of the railroad tracks. The Detroit City Gas Company previously leased this area from 1927-37 for the operation of a gas purification facility. Waste materials from this operation in the form of blue ferric ferrocyanide filings (Prussian Blue) have been encountered in this area. Prussian Blue is also typically used in current markets as an anticaking agent in road salt. This area is currently maintained as an open field containing weeds and grassy vegetation.

The second area (AOC 7B) is also located in the northwest corner of the Facility to the south of the Steam Plant. BASF personnel suspect that low lying areas in this vicinity were backfilled with materials containing Prussian Blue. This area is currently maintained as a parking lot and landscaped frontage area between the lot and Biddle Avenue to the west.

The third recently discovered area (AOC 7C) is located in the central portion of the Facility to the north of Alkali Street and west of Wyandotte Street. BASF personnel suspect that low lying areas in this vicinity were backfilled with materials containing Prussian Blue. This area is currently maintained as an open field containing weeds and grassy vegetation.

3.10.2 Release Controls

A surface drainage control program has been implemented. Topsoil has been added at selected locations to promote vegetation growth. Topsoil and paved areas also serve to prevent direct contact with any potential Prussian Blue waste materials.

In addition, a network of groundwater extraction wells is utilized to mitigate the migration of potentially impacted groundwater from the area surrounding AOC 7C. Four extraction wells have been utilized in this area to collect groundwater in the vicinity of this AOC. Recovered groundwater is pumped to a central carbon treatment system prior to discharge to the POTW.

3.10.3 Historical Findings

During an EPA visit in February 1994, five soil samples were collected from four soil borings at AOC 7A. BASF acquired splits of the soil samples for laboratory analysis. Analytical results indicated the presence of cyanide and metals. Several PNA constituents were also detected.

3.11 Summary of Previous Facility Investigations

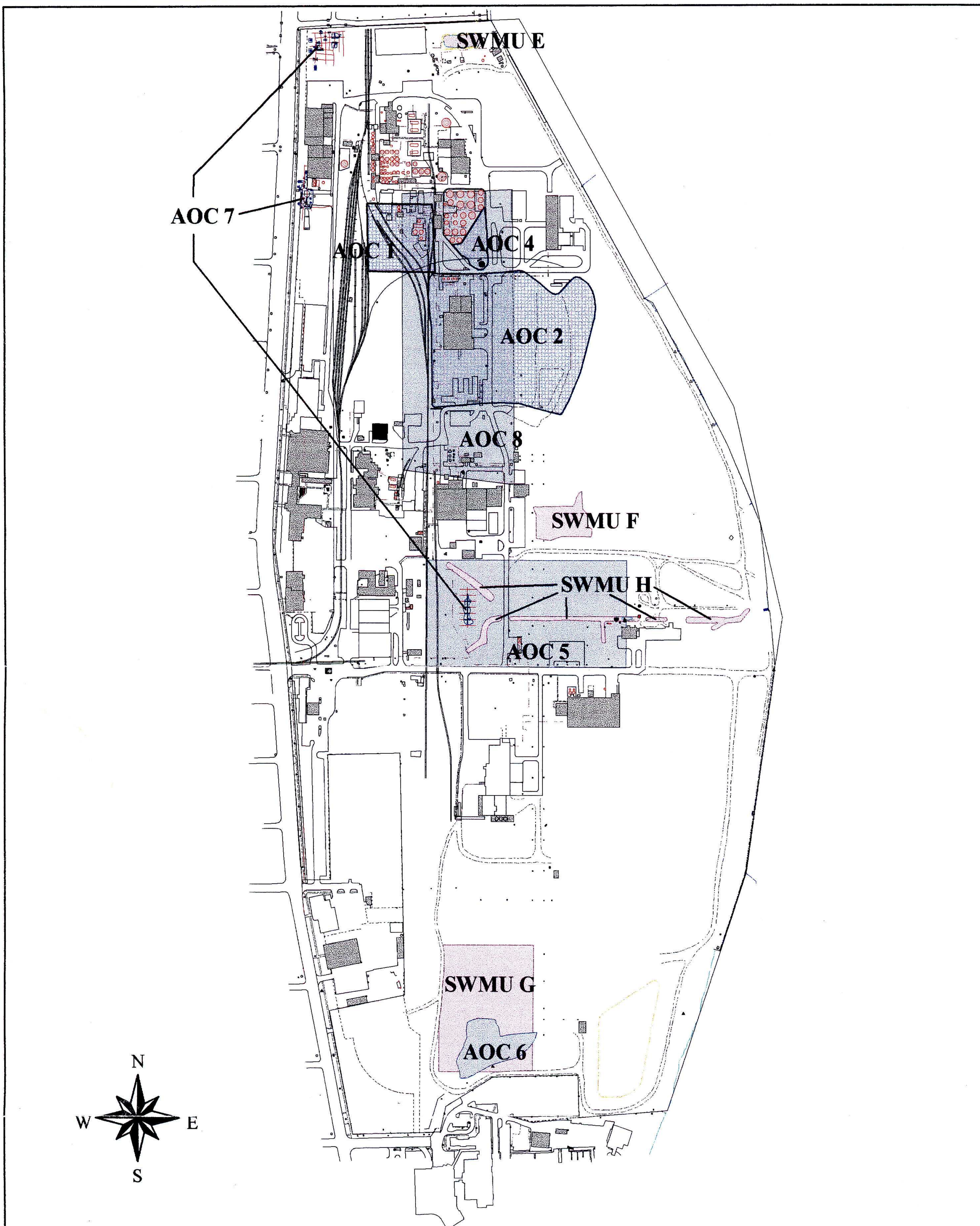
Previous Facility investigations/evaluations indicated that potential releases have occurred from various SWMUs and AOCs at the Facility. Encountered constituents varied according to the plant-specific process at or adjacent to each SWMU/AOC. Propylene dichloride, coke-related VOCs/PAHs, cyanide, and various metals were the most frequently detected constituents. Various release controls have already been implemented at the Facility including the installation/operation of a groundwater extraction system, grading/enhancement of surface drainage conditions, and sewer system improvements.

Based on these results, the Phase I RFI was designed to delineate the nature and extent of potential releases at four SWMUs and five AOCs that were not addressed, or fully characterized, in previous Facility evaluations.

BASF

RCRA Facility Investigation

Wyandotte, Michigan



LEGEND

- Solid Waste Management Unit (SWMU)
- Area of Concern (AOC)
- Storage Tank
- Building/Structure
- Perimeter Assessment Trench
- Unpaved Road
- Fenceline

500 0 500
Feet

1:6000

Revised: 02-26-99

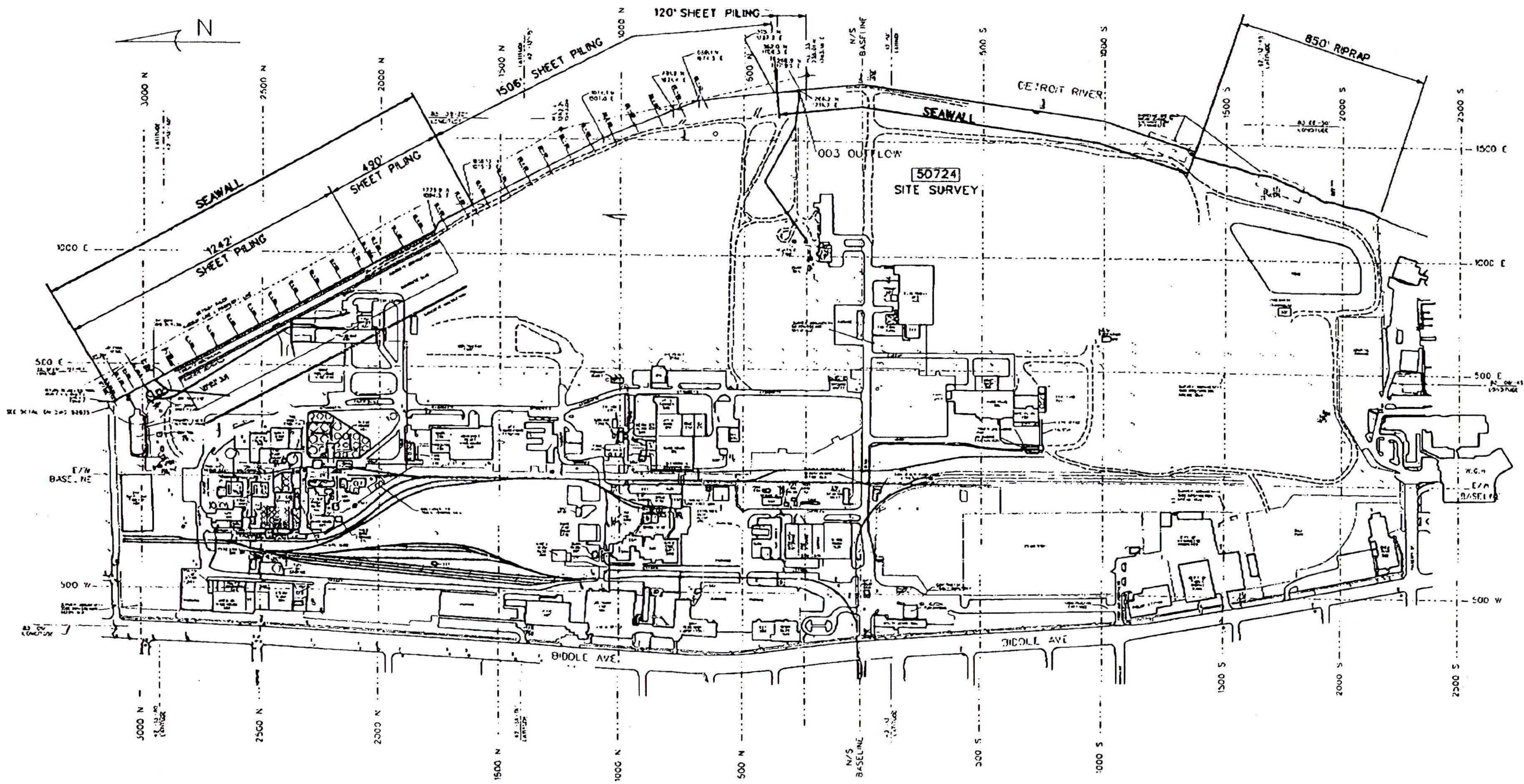
Figure 3-1. SWMU/AOC Locations at BASF-Wyandotte Facility

QST ENVIRONMENTAL

BASF

RCRA Facility Investigation

Wyandotte, Michigan



Source: BASF Corp.

QST ENVIRONMENTAL

Figure 3–2
Locations of Shoreline Improvements

4.0 PHASE I RFI OBJECTIVES AND SUPPORTING DATA REQUIREMENTS

This section describes the objectives of the Phase I RFI activities. Specifically, it reviews the objectives of the Phase I RFI, identifies data needed to meet these objectives, and describes the overall approach that was followed to obtain these data. An overview and justification of the Phase I RFI approach are also provided, as well as a discussion of the role of preliminary site-specific action levels (PSALs) in the project. In addition, this section summarizes specific data quality objectives selected for the Phase I RFI.

4.1 Project Objectives

Consistent with the terms of the Consent Order, the Phase I RFI is designed to address the following project objectives:

(1) describe the nature and extent of any releases of hazardous waste/constituents from regulated units, SWMUs, and other AOCs;

(2) evaluate the effectiveness of the current groundwater extraction system; and

(3) gather necessary data to support future Corrective Action requirements (if necessary).

Completion of critical project elements and achievement of the specific Phase I RFI objectives requires the identification, collection, and evaluation of site-specific and other local data. The results of the Phase I RFI will be utilized in developing appropriate preliminary soil and groundwater screening levels, where appropriate, for the Facility.

For site locations and depths where soil or groundwater concentrations exceed the appropriate preliminary screening levels and a risk analysis shows a threat being posed to human health or the environment, BASF will pursue the development of applicable Corrective Measures alternatives. For Facility locations and depths where constituent concentrations do not exceed the appropriate preliminary screening levels, BASF will remove these locations from further Corrective Action requirements, thereby conserving resources which would otherwise have been expended on unnecessary activities. Such an approach will allow BASF to focus its attention and efforts more rapidly and practically on any significant environmental issues instead of perceived ones.

BASF believes that the RFI scope, upon completion, will adequately characterize releases of hazardous waste/constituents as required by the Consent Order and will achieve the objectives outlined above. Any Phase II investigation activities will be designed to satisfy delineation criteria and provide data necessary for development of alternatives under a Corrective Measures Study (CMS).

4.2 Data Needs and Usage

An investigation to delineate the nature and extent of any releases at the Facility requires various types and amounts of information. Specific investigation approaches, methodologies, and data are required to facilitate the investigation process. This section of the document summarizes the general strategy presented in the RFI Workplan for collection of the data needed to achieve the investigation objectives at the Facility.

Based on a review of previous investigation results and an evaluation of site-wide conditions, sampling plans were prepared to delineate the nature and extent of any releases. Soil, groundwater, and stormwater sampling locations were selected in and around the SWMUs/AOCs at locations where constituents of concern were most likely to be found based on historical knowledge, prior investigation results, hazardous wastes/constituents managed at the various SWMUs/AOCs, and field screening criteria (visual observations and portable instrument screening). In accordance with the approved RFI Workplan, selected samples were collected and submitted for laboratory analyses.

In addition, aquifer testing plans were prepared to evaluate the effectiveness of the current groundwater extraction system. In-situ testing was utilized to determine flow gradients, permeability, flowrates, and other hydrogeological properties of the saturated zone. Test results were used to evaluate whether the existing system prevents impacted groundwater from leaving the Facility.

4.3 Data Quality Objectives

The intended use of the various data types was evaluated to establish appropriate data quality objectives. A summary of this evaluation is provided below.

As described in the USEPA-approved RFI Workplan, the following DQO levels were deemed appropriate:

1) DQO Level I was deemed appropriate to conduct screening and acquire data for basic site characterization, e.g. pH, temperature, specific conductance, water level elevations, physical descriptions, PID readings, and other similar geologic/hydrogeologic information. Specifically, the data acquired under DQO Level I were used to:

- detect changes in groundwater characteristics;
- map the water table and calculate groundwater flow gradients;
- evaluate migration pathways;
- describe basic physical properties of investigated media; and
- verify adequate purging of monitoring wells.

2) DQO Level II was deemed appropriate to complete field analyses for evaluating physical properties of the groundwater-bearing units, e.g. surveying instrumentation, pressure transducers, and data loggers. The data acquired under DQO Level II was used to verify locate sampling locations and assess the distribution of porous/permeable layers at the Facility.

3) DQO Level III was deemed appropriate for characterizing waste samples using off-site laboratory analyses. The data acquired under DQO Level III was used to characterize waste streams, acquire basic geotechnical information in accordance with ASTM methods, and identify hazardous wastes.

4) DQO Level IV was deemed appropriate for soil, groundwater, and stormwater sample analyses. The data acquired under DQO Level IV was used to characterize constituent concentrations in various media and delineate the nature/extent of any releases of hazardous wastes/constituents. These data may also be used to determine soil/groundwater clean-up objectives, support a risk assessment, and support engineering evaluations necessary to select and design Corrective Measures, if required.

5) DQO Level V (non-standard) was deemed appropriate to evaluate filter cake from SWMU F for spontaneous combustion properties.

4.4 Preliminary Site-Specific Action Levels (PSALs)

Preliminary site-specific action levels (PSALs) are commonly developed and used at both Corrective Action and CERCLA sites to determine whether field investigations should proceed beyond an initial phase. In fact, this concept is inherent to both the proposed RCRA Subpart S rule (as well as other proposed rulemakings) and guidance being developed and implemented under the Corrective Action and Superfund programs. BASF believes that such a concept is appropriate for the Facility and has developed conservative values against which the RFI data have been evaluated.

This section identifies these conservative values (PSALs) that have been used to determine the need for further investigation or to recommend no further action. PSALs were utilized as a comparative baseline for analytical results, e.g. to determine whether a release has been fully delineated in soil or assess whether groundwater/stormwater impacts are present. These PSALs are being used to focus the risk assessment process on the relevant constituents and SWMUs/AOCs of concern.

For the purposes of this RFI, PSALs represent values which incorporate both risk-based action levels and site-specific background levels. As a result, the comparative process for analytical results is simplified.

As prescribed in the RFI Workplan, PSALs were derived for soils (fill and sand) from Groundwater Surface Water Interface (GSI) based levels (GSI values x 20) determined by the Michigan Department of Environmental Quality (MDEQ), Surface Water Quality Division, as of January 28, 1997. For ubiquitous PAHs and metals, the background concentration was utilized as the PSAL, if greater than the MDEQ GSI-based criteria. For instances where the GSIs or background values were unavailable, alternative USEPA Soil Screening Levels (SSLs), Region 9 Preliminary Remediation Goal (PRG) values, or Region 3 Risk-Based Concentration (RBC) values were used.

PSALs for groundwater/stormwater were derived in a similar manner using GSI-based levels (GSI values x 1). For metals and cyanide, the background concentration was utilized as the PSAL if greater than the MDEQ criteria. For instances where the GSIs or background values were unavailable, alternative USEPA SSLs, Region 9 PRG values, or Region 3 RBC values were used.

Soil and groundwater PSALs are presented in Tables 4-1 and 4-2, respectively, for the constituents detected in the Phase I RFI. These tables also include the relevant MDEQ GSI-based criteria, alternative risk-based reference values (e.g. SSLs, PRGs, RBCs), and site-specific background levels, as appropriate.

Table 4-1
Determination of Preliminary Site-Specific Action Levels for Soils
(All values in ug/kg except metals)
BASF-Wyandotte Phase I RFI
(Page 1 of 2)

Constituent	BASF Preliminary Site-Specific Action Level for FILL (1)	BASF Preliminary Site-Specific Action Level for SAND (2)	MDEQ GSI-Based Soil Cleanup Level (3)	CERCLA Soil Screening Levels (SSLs) (4)	Background Fill Concentration (5)	Background Sand Concentration (6)
VOLATILE ORGANIC COMPOUNDS (VOCs)						
Acetone	500,000	500,000	500,000	16,000	--	--
Benzene	1,060	1,060	1,060	30	--	--
2-Butanone (MEK)	144,000	144,000	144,000	-	--	--
Carbon Disulfide	32,000	32,000	-	32,000	--	--
Carbon tetrachloride	420	420	420	70	--	--
Chlorobenzene	520	520	520	1,000	--	--
Chloroform	1,600	1,600	1,600	600	--	--
1,2-Dichlorobenzene	140	140	140	17,000	--	--
1,1-Dichloroethane	23,000	23,000	-	23,000	--	--
1,2-Dichloropropane	1,280	1,280	1,280	30	--	--
Ethylbenzene	620	620	620	13,000	--	--
4-Methyl-2-pentanone (MIBK) (7)	5,200,000	5,200,000	--	-	--	--
Methylene chloride	1,180	1,180	1,180	20	--	--
Styrene	380	380	380	4,000	--	--
Tetrachloroethene	440	440	440	60	--	--
Toluene	2,200	2,200	2,200	12,000	--	--
1,1,1-Trichloroethane	2,400	2,400	2,400	2,000	--	--
Trichloroethene	1,880	1,880	1,880	60	--	--
1,2,3-Trichloropropane (7)	6.6	6.6	-	-	--	--
m-Xylene	1,180	1,180	1,180	210,000	--	--
o-Xylene	1,180	1,180	1,180	190,000	--	--
p-Xylene	1,180	1,180	1,180	200,000	--	--
SEMI-VOLATILE ORGANIC COMPOUNDS (SVOCs)						
Acenaphthene	470	408	76	570,000	470	408
Acenaphthylene	470	408	-	-	470	408
Acetophenone (7)	5,600,000	5,600,000	-	-	470	408
Anthracene	2,200,000	2,200,000	2,200,000	12,000,000	546	408
Benzo(a)anthracene	972	397	6.2	2,000	972	397
Benzo(b)fluoranthene	1,310	408	6.2	5,000	1310	408
Benzo(k)fluoranthene	586	408	6.2	49,000	586	408
Benzo(g,h,i)perylene	687	408	-	-	687	408
Benzo(a)pyrene	881	408	6.2	8,000	881	408
Benzyl Alcohol	440	440	440	-	470	408
Bis(2-chloroethyl) ether	118	118	118	0.4	470	408
Bis(2-chloroisopropyl) ether (8)	6,700	6,700	-	-	470	408
Butyl benzyl phthalate	930,000	930,000	-	930,000	470	408
4-Chloro-3-methylphenol	88	88	88	--	470	408
2-Chlorophenol	200	200	200	--	470	408
Chrysene	794	391	6.2	160,000	794	391
Dibenz(a,h)anthracene	580	408	6.2	2,000	580	408
Dibenzofuran (8)	260,000	260,000	-	-	542	408
Diethyl phthalate	2,400,000	2,400,000	2,400,000	-	477	408
2,4-Dimethylphenol	600	600	600	9,000	470	408
2,4-Dinitrotoluene	1,820	1,820	1,820		470	408
Di(n)octyl phthalate	10,000,000	10,000,000	-	10,000,000	470	408
1,4-Dioxane	40,000	40,000	40,000	-	--	--
Bis(2-ethylhexyl) phthalate	1,180	1,180	1,180	3,600,000	470	408
Fluoranthene	7,400	7,400	7,400	4,300,000	1,265	365
Fluorene	280,000	280,000	280,000	560,000	470	408
Indeno(1,2,3-cd)pyrene	671	408	6	14,000	671	408
2-Methylnaphthalene	680	680	680	-	538	408
2-Methylphenol (o-cresol)	760	760	760	15,000	470	408
3-Methylphenol (m-cresol) (7)	2,000,000	2,000,000	-	-	470	408
4-Methylphenol (p-cresol)	124	124	124	-	470	408
Naphthalene	680	680	680	84,000	494	408
4-Nitrophenol (9)	84,000	84,000	-	-	2,280	2,228
N-Nitroso-di-n-propylamine	0.05	0.05	-	0.05	470	408
Pentachlorophenol	16	16	16	30	7	6

Table 4-1
Determination of Preliminary Site-Specific Action Levels for Soils
(All values in ug/kg except metals)
BASF-Wyandotte Phase I RFI
(Page 2 of 2)

Constituent	BASF Preliminary Site-Specific Action Level for FILL (1)	BASF Preliminary Site-Specific Action Level for SAND (2)	MDEQ GSI-Based Soil Cleanup Level (3)	CERCLA Soil Screening Levels (SSLs) (4)	Background Fill Concentration (5)	Background Sand Concentration (6)
Phenanthrene	656	408	-	-	656	408
Phenol	22,000	22,000	22,000	100,000	470	408
Pyrene	220,000	220,000	220,000	4,200,000	1,268	363
1,2,4-Trichlorobenzene	440	440	440	5,000	470	408
PESTICIDES/PCBs						
Aroclors (1242,1248,1254,1260)	4.0E-04	4.0E-04	4.0E-04	1,000	-	-
alpha-Chlordane	1.1E-02	1.1E-02	1.1E-02	10,000	-	-
4,4'-DDE	0.12	0.12	0.12	54,000	-	-
HERBICIDES						
2,4-D	940	940	940	-	-	-
2,4,5-T (8)	650,000	650,000	-	-	-	-
2,4,5-TP (Silvex)	420	420	420	-	-	-
METALS/CYANIDE (mg/kg)						
Antimony	1.1	1.0	1.00	5.0	1.1	0.6
Arsenic	12.0	7.0	1.00	29.0	12.0	7.0
Barium	255.8	25.3	12.60	1600.0	255.8	25.3
Beryllium	1.5	0.6	-	1600.0	1.5	0.6
Cadmium	2.1	0.1	0.01	8.0	2.1	0.1
Chromium	23.9	12.6	1.54	38.0	23.9	12.6
Cobalt	8.9	6.2	-	-	8.9	6.2
Copper	46.1	10.2	0.36	2900.0	46.1	10.2
Lead	63.3	3.6	0.13	400.0	63.3	3.6
Mercury	0.8	0.1	2.6E-05	2.0	0.8	0.1
Nickel	22.3	9.8	1.14	130.0	22.3	9.8
Selenium	3.5	0.6	0.10	5.0	3.5	0.6
Silver	3.0	1.2	2.0E-03	34.0	3.0	1.2
Thallium	3.0	1.2	0.11	0.7	3.0	1.2
Tin (7)	46,000.0	46,000.0	-	-	142.2	123.2
Vanadium	41.1	28.2	0.16	6000.0	41.1	28.2
Zinc	216.8	19.3	1.62	12000.0	216.8	19.3
Cyanide (amenable)	0.1	0.1	0.10	40.0	-	-

Listed constituents were detected in the Phase I RFI.
-- Applicable value not available.

Footnotes:

1&2 Preliminary Site-specific Action Levels (PSALs) were derived for subsurface soils (fill and sand) from Groundwater Surface Water Interface (GSI) Based Levels (GSI Values x 20) determined by MDEQ Surface Water Quality Division, as of January 28, 1997, for all fractions except ubiquitous PAHs and metals. For ubiquitous PAHs and metals, the background concentration was utilized as the PSAL if greater than the MDEQ criteria. For instances where the GSIs or background values were unavailable, alternative USEPA Soil Screening Levels (SSLs), Region IX Preliminary Remediation Goal (PRG) values, or Region III Risk-Based Concentration (RBC) values were used as referenced below.

3 MDEQ GSI Values, January 28, 1997. GSI values were utilized in MDNR Generic Industrial and Commercial Cleanup Criteria documents prepared by Environmental Response Division (ERD) of MDEQ.

4 Soil Screening Levels, July 1996.

5 Background Fill Concentrations are represented by the following statistical values:
- For parameters detected within the background fill samples, the value is the mean background concentration plus 3 standard deviations
- For parameters NOT detected within the background fill samples, the value is the mean concentration

6 Background Sand Concentrations are represented by the following statistical values:
- For parameters detected within the background sand samples, the value is the mean background concentration plus 3 standard deviations
- For parameters NOT detected within the background sand samples, the value is the mean concentration

7 Alternative value acquired from USEPA Region V Data Quality Levels, December 1995.

8 Alternative value acquired from EPA Region IX Preliminary Remediation Goals, August 1, 1996.
- Levels for migration to groundwater (GW) pathway based on dilution and attenuation factor of 10
- Levels for metals based on a pH = 8.0

9 Alternative value acquired from EPA Region III Risk-Based Concentration Table, April 30, 1996.

Table 4-2
Determination of Preliminary Site-Specific Action Levels for Groundwater
(All values in ug/L except metals)
BASF-Wyandotte Phase I RFI

CONSTITUENT	BASF Preliminary Site-Specific Action Level for Groundwater (1)	MDEQ GSI-Based Groundwater Cleanup Level (2)	CERCLA Soil Screening Levels (SSLs) (3)	Background Groundwater Concentration (4)
VOLATILE ORGANIC COMPOUNDS (VOCs)				
Acetone	25,000	25,000	800	10
Benzene	53	53	2	0.47
2-Butanone (MEK)	7,200	7,200	-	10
Carbon disulfide	1,600	-	1,600	0.49
Carbon tetrachloride	21	21	3	1
Chlorobenzene	26	26	70	1
Chloroform	80	80	30	0.57
1,2-Dichlorobenzene	7	7	900	1
1,1-Dichloroethane	1,000	-	1,000	1
1,2-Dichloroethane	560	-	-	1
1,1-Dichloroethene	32	-	-	1
1,2-Dichloropropane	64	64	1	1
Ethylbenzene	31	31	700	1
4-Methyl-2-pentanone (MIBK) (5)	2,900	-	-	10
Methylene chloride	59	59	1	0.50
Styrene	19	19	200	1
Tetrachloroethene	22	22	3	1
Toluene	110	110	600	1
1,1,1-Trichloroethane	120	120	100	1
Trichloroethene	94	94	3	1
1,2,3-Trichloropropane (5)	31	-	-	1
Vinyl chloride	3.1	3.1	0.7	1.0
m-Xylene	59	59	10,000	1
o-Xylene	59	59	9,000	1
p-Xylene	59	59	10,000	1
SEMI-VOLATILE ORGANIC COMPOUNDS (SVOCs)				
Acenaphthene	5	3.8	29,000	5
Acenaphthylene	5	-	-	5
Acetophenone (5)	3700	-	-	10
Anthracene	110000	110,000	590,000	5
Benzo(a)anthracene	5	0.3	80	5
Benzo(b)fluoranthene	5	0.3	200	5
Benzo(k)fluoranthene	5	0.3	2,000	5
Benzo(ghi)perylene	5	-	-	5
Benzo(a)pyrene	5	0.3	400	5
Benzyl Alcohol	22	22	-	10
bis(2-Chloroethyl) ether	10	5.9	0.02	10
bis(2-Chloroisopropyl) ether (6)	10	-	-	10
Butyl benzyl phthalate	810000	-	810,000	5
4-Chloro-3-methylphenol	5	4	-	5
2-Chlorophenol	10	10	-	5
Chrysene	5	0.3	8,000	5
Dibenz(a,h)anthracene	5	0.3	80	5
Dibenzofuran (5)	150	-	-	5
2,6-Dichlorophenol	10			10
Diethyl phthalate	120000	120,000	-	2.5
2,4-Dimethylphenol	30	30	400	5
2,4-Dinitrotoluene	91	91		5
Di(n)octyl phthalate	10000000	-	10,000,000	10
1,4-Dioxane	2000	2,000	-	23
bis(2-Ethylhexyl) phthalate	59	59	180,000	3
Fluoranthene	370	370	210,000	5
Fluorene	14000	14,000	28,000	5
Indeno(1,2,3-cd)pyrene	5	0.3	700	5
2-Methylnaphthalene	34	34	-	5
2-Methylphenol (o-cresol)	38	38	800	5
3-Methylphenol (m-cresol) (5)	1800	-	-	10
4-Methylphenol (p-cresol)	10	6	-	10
Naphthalene	34	34	4,000	5
4-Nitrophenol (7)	2300	-	-	50
N-Nitroso-di-n-propylamine	5	-	2.00E-03	5

Table 4-2
Determination of Preliminary Site-Specific Action Levels for Groundwater
(All values in ug/L except metals)
BASF-Wyandotte Phase I RFI
(Page 2 of 2)

CONSTITUENT	BASF Preliminary Site-Specific Action Level for Groundwater (1)	MDEQ GSI-Based Groundwater Cleanup Level (2)	CERCLA Soil Screening Levels (SSLs) (3)	Background Groundwater Concentration (4)
Pentachlorophenol	50	0.8	1	50
Phenanthrene	5	-	-	5
Phenol	1100	1,100	5,000	5
Pyrene	11000	11,000	210,000	5
Pyridine	10	-	-	10
o-Toluidine	10	-	-	10
1,2,4-Trichlorobenzene	22	22	300	5
PESTICIDES/PCBs				
Aroclors (1242,1248,1254,1260)	2.0E-05	2.0E-05	1,000	0.50
alpha-Chlordane	5.3E-04	5.3E-04	500	0.05
4,4'-DDE	0.01	0.01	3,000	0.10
HERBICIDES				
2,4-D	47	47	-	0.50
2,4,5-T (5)	3700	-	-	0.20
2,4,5-TP (Silvex)	21	21	-	0.10
METALS/CYANIDE (mg/L)				
Antimony	0.050	0.050	0.3	0.003
Arsenic	0.050	0.050	1.0	0.021
Barium	0.630	0.630	82.0	0.271
Beryllium	3.00	-	3.0	0.005
Cadmium	0.0008	0.0006	0.4	0.0008
Chromium	0.743	0.077	2.0	0.743
Cobalt	0.025	-	-	0.025
Copper	0.031	0.018	150.0	0.031
Lead	0.010	0.007	400.0	0.010
Mercury	0.0001	1.3E-06	0.1	0.0001
Nickel	0.238	0.057	7.0	0.238
Selenium	0.005	0.005	0.3	0.003
Silver	0.005	1.0E-04	2.0	0.005
Thallium	0.010	0.005	0.04	0.010
Tin (5)	22	-	-	1.000
Vanadium	0.027	0.008	300.0	0.027
Zinc	0.081	0.081	620.0	0.075
Total Cyanide	0.172	0.005	2.0	0.172

Listed constituents were detected in the Phase I RFI.
- Applicable value not available.

Footnotes:

1 Preliminary Site-specific Action Levels (PSALs) were partially derived for groundwater from Groundwater Surface Water Interface (GSI) Values determined by MDEQ Surface Water Quality Division, as of January 28, 1997. For SVOCs, the quantitation limit was utilized as the PSAL if greater than the MDEQ criteria. For metals and cyanide, the background concentration (or quantitation limit) was utilized as the PSAL if greater than the MDEQ criteria. For instances where the GSIs or background values were unavailable, alternative USEPA Soil Screening Levels (SSLs), Region IX Preliminary Remediation Goal (PRG) values, or Region III Risk-Based Concentration (RBC) values were used as referenced below.

2 MDEQ GSI Values, January 28, 1997. GSI values were utilized in MDNR Generic Industrial and Commercial Cleanup Criteria documents prepared by Environmental Response Division (ERD) of MDEQ.

3 Soil Screening Levels, July 1996, 1x DAF value for migration to groundwater.

4 Background Groundwater Concentrations are represented by the following statistical values:
- For parameters detected within the background groundwater samples, the value is the mean background concentration.
- For parameters NOT detected within the background groundwater samples, the value is the quantitation limit.

5 Alternative value acquired from USEPA Region V Data Quality Levels, December 1995.

6 Alternative value acquired from EPA Region IX Preliminary Remediation Goals, August 1, 1996.

7 Alternative value acquired from EPA Region III Risk-Based Concentration Table, April 30, 1996.

5.0 PHASE I RFI FIELD ACTIVITIES

This section summarizes the Phase I RFI field activities which were conducted to define the nature and extent of hazardous waste/constituent releases at the Facility. These activities included: geophysical surveys of selected areas, soil boring installations, soil sampling and analyses, monitoring well/piezometer completion, groundwater monitoring and analyses, stormwater runoff sampling and analyses, and aquifer test activities. In general, Phase I RFI field activities were completed on a SWMU/AOC-specific basis for soils and a site-wide basis for groundwater evaluation purposes. Figure 5-1 provides a summary of Phase I RFI soil boring and monitoring well locations.

The following general chronology of field activities was completed to fulfill the Phase I RFI scope of work as outlined in the RFI Workplan:

1) Performance of two limited geophysical surveys at AOC 4 and AOC 6;

2) Installation of over three hundred (300) investigative soil borings across the site to assess geological and hydrogeological conditions beneath the Facility;

3) Installation of twenty nine (29) groundwater monitoring wells to assess hydrogeological conditions beneath the Facility;

4) Installation of two staff gauges along the shoreline of the Detroit River to assess hydrogeological conditions adjacent to the Facility;

5) Sampling of subsurface soils utilizing continuous and discrete interval split spoon collection methods;

6) Collection of background soil samples for field screening and laboratory analyses;

7) Collection of subsurface soil samples for field screening and laboratory analyses;

8) Collection of surface soil samples from SWMU G for field screening and laboratory analyses;

9) Collection of three (3) stormwater runoff samples for laboratory analyses;

10) Collection of groundwater samples for field screening and laboratory analyses;

11) Installation of one (1) groundwater piezometer to assist in assessing hydrogeological conditions beneath the Facility;

12) Re-development of existing monitoring wells and piezometers;

13) Performance of aquifer slug and pumping tests; and,

14) Monitoring of groundwater potentiometric surface.

All Phase I RFI field activities were conducted in accordance with the protocols described in the Quality Assurance Project Plan (QAPP) and Health and Safety Plan (HASP).

5.1 Geophysical Surveys

Two limited geophysical surveys were conducted at AOC 4 and AOC 6 to evaluate subsurface conditions in a non-intrusive manner. The surveys were performed in accordance with QAPP-specified protocols.

An electrical resistivity survey was completed at AOC 4 to evaluate the horizontal and vertical extent of the tar pit below the crushed limestone surface material. The survey was conducted using a Sting R1 memory earth resistivity instrument and a Swift automatic multi-electrode data logger. Initial difficulties were encountered as a result of the high contact resistance created by the limestone along the surface of the AOC. However, a salt water solution was utilized to reduce the baseline resistance readings to acceptable levels. Three transects were subsequently evaluated as part of this survey at AOC 4.

An electrical conductivity survey was completed at AOC 6 to evaluate the potential presence of tar beneath AOC 6 and assist with the placement of soil borings. The survey was conducted using a Geonics EM-31 terrain conductivity meter. Survey data were collected at 25-foot spacings along nine traverses. Each traverse was 200 ft in length.

Results for both of the geophysical surveys are provided in Section 7.0.

5.2 Installation of Soil Borings

Soil borings were installed at various locations to evaluate the nature and extent of any hazardous waste or hazardous constituent releases to soils at the Facility. The soil boring activities were also completed to further evaluate the geological and hydrogeological systems at the Facility.

Under the supervision of QST field personnel, drilling activities were conducted by Carlo Environmental and QST-Williamston. Drilling services provided by Carlo Environmental were performed using a truck-mounted Dietrich D-50 drilling rig. Drilling services provided by QST-Williamston were performed using a truck-mounted KeckPunch hydraulic rig.

Soil borings were installed using standard hollow-stem auger (HSA) drilling and hydraulic soil probe methodologies. Soil borings completed with the Dietrich D-50 drilling rig were advanced using 6 1/4-inch (or 4 1/4-inch) internal diameter (ID) hollow-stem augers. Direct push soil borings completed with the KeckPunch rig were advanced using 1.75-inch ID steel probing rods.

Prior to drilling at the initial and all subsequent borings, ancillary rig equipment were cleaned using a steam cleaner wash at the temporary on-site decon station to eliminate cross-contamination between successive drilling locations. The KeckPunch-related sampling tubes were cleaned between AOCs/SWMUs and detergent washed between sampling locations.

Continuous split spoon soil samples were collected from each boring for field screening, lithographic description, and subsequent chemical analysis. Each split spoon (or corresponding disposable sampling tube liner) was opened and those selected for lab analyses were immediately scanned with a PID and/or FID to identify potential presence of VOCs. To maintain lithographic descriptive consistency, each soil sample was described and classified in accordance with the Unified Soil Classification (USC) system. Two-inch diameter split-spoon samplers were used for soil sampling purposes.

Upon completion of drilling, each boring was filled with a bentonite slurry mixture to surface. Generated soil cuttings were containerized in 55-gallon DOT-approved drums for subsequent management by BASF.

Phase I RFI field activities were completed on a SWMU/AOC-specific basis in accordance with the guidelines specified in the RFI Workplan. A biased sampling approach was used to locate soil sampling locations at the various SWMUs and AOCs. The approximate locations, number of samples, and analyses were determined using the following criteria:

- guidelines specified in the RFI Workplan;
- historic aerial photographs;

- historic operations performed at a specified area
- soil boring and analytical results from prior site investigations;
- results acquired from RFI geophysical surveys (completed at AOCs 4 and 6);
- hazardous wastes or hazardous constituents managed; and
- field conditions (e.g. staining, FID/PID readings, obstructions, etc.).

5.3 Soil Sampling and Analysis

Soil samples were collected from each boring to evaluate the nature and extent of any hazardous waste or hazardous constituent releases to soils at the Facility. Soil sampling activities were also completed to further evaluate the geological and hydrogeological systems beneath the Facility. Continuous split spoon soil samples were collected from selected borings for field screening, lithographic description, and subsequent chemical analysis.

Each soil sample was screened in the field with a PID and/or FID for total organic vapors (TOV) by the headspace method. This process involved placing a portion of the soil sample into a resealable plastic bag and allowing time for volatilization, if any, to occur. The concentration of VOCs that partition from the soil to the gaseous state were then recorded in parts per million (ppm) by placing the PID probe into the container headspace.

All field screening equipment was calibrated at a minimum of once per day during Phase I RFI field efforts. Instrument calibration was performed in accordance with the manufacturers' recommended procedures using either commercially available or laboratory-provided calibration standards. All calibration data were recorded in the Field Equipment Calibration Logbook.

Selected soil samples collected during the Phase I RFI field activities were submitted for laboratory analysis. Samples were collected per the specifications in the USEPA-approved RFI Workplan.

Duplicate, field blank, and trip blank samples were collected and analyzed in accordance with the QAPP specifications. The soil duplicate and field blank samples were analyzed for SWMU/AOC-specific parameters. Trip blank samples were analyzed for VOCs only.

Upon collection, each soil sample was managed according to the procedures described below. These procedures were established in accordance with the QAPP. Appropriate USEPA analytical methods, sample preservation techniques, sample volumes, and holding times are also presented in the QAPP.

Samples were collected into sample containers which were pre-cleaned and assembled to USEPA's Protocol "B". The volume of sample collected and the type of container used was determined by the suggested volumes described in SW-846 for the particular analysis. A summary of the bottle requirements and sample volumes is included in the QAPP.

Immediately upon collection, each sample was properly labeled to prevent misidentification. The sample labels were made of waterproof material and filled out with waterproof ink. The sample labels included the sample number, sample location, sample depth, date sampled, time sampled, analyses to be performed, and sample collector's name.

After labeling, the samples were placed into an appropriate shipping container. Samples collected for organic analysis were placed into a shipping container with sufficient ice or ice packs to preserve samples during transport to the laboratory. The samples were appropriately packaged in the shipping container to minimize the potential for damage during shipment. A completed chain-of-custody form was placed in each shipping container to accompany the samples to the laboratory. The shipping containers were then sealed with several strips of strapping tape.

The sample containers were shipped via overnight courier to the Quanterra Environmental Services (Quanterra) in North Canton, Ohio. Samples were shipped so that the laboratory received the samples within 24 hours from the time of shipment. Isolated deviations from these prescribed time periods were documented in the data validation reports (Appendix D). Strict chain-of-custody procedures were maintained during sample handling.

A chain-of-custody program was followed to track the possession and handling of individual samples from time of collection through completion of laboratory analysis. Copies of the chain-of-custody record were retained in the permanent file for proper documentation. The chain-of-custody forms included:

- Sample number
- Date and time of collection
- Sample type (e.g., soil, groundwater, etc.)
- Number of containers
- Parameters requested for analysis
- Signature of person(s) involved in the chain of possession
- Inclusive dates of possession

Soil samples were analyzed for SWMU/AOC-specific parameters in accordance with the QAPP. The analytical parameters were selected in accordance with USEPA sampling requirements.

Laboratory analyses were conducted in accordance with appropriate USEPA methodologies as prescribed in the QAPP.

A summary of the sampling and analytical approaches for soils from the background and Facility areas is provided below.

5.3.1 Background Soil Sampling and Analysis

Background soil samples were collected to evaluate constituent levels at Facility locations that were believed to be unaffected by the Facility or the SWMUs/AOCs being investigated. Soil samples were screened in the field for VOCs. Soil samples were analyzed for the presence of VOCs, SVOCs, pesticides, herbicides, metals, and total cyanide. Analytical results for the background soil samples are provided in Section 7.0.

5.3.2 Facility Soil Sampling and Analysis

Soil sampling was performed to 1) delineate the horizontal and vertical extent of any potential releases at the Facility and 2) define the geological and hydrogeological systems beneath the Facility. Subsequent soil analyses were conducted to provide a quantitative evaluation of constituent impacts to soil at the Facility. Soil samples were analyzed on a SWMU/AOC-specific basis in accordance with the guidelines specified in the RFI Workplan. Analytical results for the soil samples are provided in Section 7.0.

5.4 Installation of Monitoring Wells

Twenty nine (29) monitoring wells (RFIMW-1 thru RFIMW-29) were installed to supplement the existing network of Facility monitoring wells and facilitate a site-wide assessment of groundwater conditions. The monitoring wells were also completed to evaluate the potentiometric surface of the deeper water-bearing unit beneath the Facility.

The monitoring well network was installed to evaluate potentially impacted groundwater on a site-wide basis. Six of the monitoring wells (RFIMW-24 thru RFIMW-29) were installed along the western perimeter of the Facility to monitor background conditions. Monitoring well RFIMW-29 was installed to serve as a background replacement for P-35-N which received damage in the southwest portion of the Facility. The remaining twenty three monitoring wells (RFIMW-1 thru RFIMW-23) were installed along the northern, eastern, and southern boundaries to evaluate potential Facility impacts to groundwater.

Monitoring well installation activities were conducted by Carlo Environmental under the supervision of QST field personnel. Each well was installed to a depth of at least 2 ft into the lacustrine clay unit (generally 20-25 ft bls) in accordance with the QAPP and the following general protocols:

1) Prior to installation of each monitoring well, the screen and riser pipe were steam-cleaned to ensure that all oils, greases, and waxes were removed.

2) Each monitoring well was constructed of 2-inch diameter, stainless steel with flush-threaded joints. Two (2)-ft screen sections were installed to the top of the Lacustrine Clay Unit.

3) The artificial sand pack consisted of chemically inert, rounded, silica sand and was placed by a tremie method to a height of approximately two feet above the top of the screen.

4) A bentonite pellet seal two feet in thickness was placed by a tremie method above the sand pack material.

5) The annular space above the bentonite pellet seal was sealed with cement/bentonite grout by the tremie method.

6) Each monitoring well was completed with either a flush-mounted or stick-up, water-tight protective casing.

Well construction details were recorded on standard field forms.

5.5 Groundwater Monitoring Events

Six groundwater monitoring events (3 monthly and 3 quarterly) were subsequently conducted to acquire groundwater quality/elevation data at the Facility. The initial monitoring event (September 1996) included coverage of the seven background monitoring wells, fifteen perimeter monitoring wells, and ten additional "non-network" monitoring wells. These non-network wells were sampled only for this initial event. Two additional monitoring events (October 1996 and November 1996) were then completed to evaluate conditions for the seven background monitoring wells only. Three subsequent quarterly monitoring events (December 1996, March 1997, and June 1997) were completed to provide additional groundwater quality/elevation data for the seven background monitoring wells and the fifteen perimeter monitoring wells. Monitoring well locations are displayed in Figure 5-2.

Water level measurements were performed using an electronic water level probe and measured to the nearest 1/100 foot. Data were recorded in a field notebook and subsequently transferred to a standard monitoring form.

Prior to the collection of groundwater samples, each monitoring well was purged using either a disposable polyethylene bailer or submersible pump. Each monitoring well was purged by removing a minimum of three well casing volumes of groundwater and obtaining stabilized field parameter readings, or until dry. Samples were then collected using a disposable bottom-loading bailer using appropriate collection procedures as specified in the QAPP.

Duplicate, field blank, and trip blank samples were collected and analyzed in accordance with the QAPP specifications. Blind groundwater duplicate samples were also collected and identified with an artificial identity (i.e. RFIMW-30). The soil duplicate and field blank samples were analyzed for SWMU/AOC-specific parameters. Trip blank samples were analyzed for VOCs only.

Upon collection, each groundwater sample was managed in accordance with QAPP-specified protocols. Appropriate USEPA analytical methods, sample preservation techniques, sample volumes, and holding times are also presented in the QAPP. Each sample was collected and placed in an appropriate sample container and submitted for laboratory analysis.

Groundwater samples from the perimeter and background monitoring wells were analyzed for constituents specified under 40 CFR 264 Appendix IX (VOCs, SVOCs, PCBs/pesticides, herbicides, metals [dissolved and total], cyanide, and sulfide). Analytical parameters for other specific monitoring wells were selected based on knowledge of chemical usage at the Facility. Laboratory analyses were conducted in accordance with appropriate USEPA methodologies as prescribed in the QAPP.

5.6 Stormwater Runoff Sampling and Analysis

A stormwater runoff sampling event was conducted to acquire data regarding stormwater runoff quality at the Facility. Sampling locations were selected at Facility areas where stormwater runoff flows off-site prior to collection or containment. Based on an assessment of runoff patterns during a heavy rain event, three sampling locations were selected as follows:

- along the northern property boundary of the Facility to the east of AOC 7A;
- along the shoreline of the Detroit River on the southeast side of the Facility adjacent to AOC 6; and,
- adjacent to cemetery on the west central portion of the Facility.

Each stormwater runoff sample was collected using appropriate collection procedures as specified in the QAPP. Upon collection, each stormwater runoff sample was managed in accordance with QAPP-specified protocols. Appropriate USEPA analytical methods, sample preservation techniques, sample volumes, and holding times are also presented in the QAPP. Each sample was collected and placed in an appropriate sample container and submitted for laboratory analysis.

Stormwater runoff samples were analyzed for constituents specified under 40 CFR 264 Appendix IX (VOCs, SVOCs, PCBs/pesticides, herbicides, metals [total], cyanide, and sulfide). Laboratory analyses were conducted in accordance with appropriate USEPA methodologies as prescribed in the QAPP.

5.7 Preparatory Activities for Aquifer Tests

Various preparatory activities were conducted prior to the aquifer testing efforts to maximize the utility and representative nature of the test data. The existing groundwater extraction wells were cleaned prior to testing with a water jet and/or acid rinses to remove scale deposits and surge groundwater in each well. Several of these wells (E1NA, E2NA, E3NA, and E4NA) did not respond to the cleaning/re-conditioning efforts and were replaced with new wells and/or piezometers in the same immediate vicinity. The identification codes for these wells/piezometers are identical to the original designations with the addition of an asterisk (e.g. E1NA*).

To further enhance the utility of the testing data, several new piezometers were also installed. Piezometers PE1NA, PE2NA, PE3NA, PE4NA, PE13NB, and PE14NC were each installed approximately 15 ft from the associated extraction wells. In addition, piezometer RFIPZ-1 was installed to supplement the network of available water level measurement locations.

5.8 Aquifer Slug Tests

Aquifer slug tests were performed on monitoring wells RFIMW-9 and RFIMW-19 to evaluate the hydraulic conductivity of the water-bearing unit. These well locations were selected to supplement data deficiencies in this particular area of the Facility.

The slug tests were performed by lowering the water level in each monitoring well and monitoring the rate of groundwater recovery. A plastic slug was initially inserted into the water column. Then, water levels were allowed to equilibrate prior to removing the plastic slug. The associated response time for each well was recorded using a Hermit 2000 data logger equipped with a calibrated 10 psi transducer. Water levels were recorded to the nearest 0.001 foot and referenced to the top of each well casing.

5.9 Aquifer Pump Tests

Aquifer pump tests were performed at three separate groundwater extraction wells to determine flow gradients, permeability, flowrates, and other hydrogeological properties of the saturated zone.

5.9.1 Acquisition of Baseline Water Level Data

In order to obtain essential baseline water level data, the groundwater extraction system at the Facility was shut down prior to the initiation of pump testing activities. During this period, water level data were collected at fifteen minute intervals from transducers located in monitoring wells RFIMW-6, RFIMW-8, RFIMW-11, RFIMW-18, RFIMW-20, and two temporary monitoring locations on the Detroit River (designated River N and River S). In addition, water level measurements were recorded three times per day from wells E13NB, PE13NB, E10NB, PE10NB, E14NC, PE14NC, E2NA, PE2NA, RFIMW-25, RFIMW-26, and P34N.

After a one-week period, the static water level data indicated that equilibrium had been established.

5.9.2 Step Drawdown Tests

Step drawdown tests were then conducted on extraction wells E14NC, E13NB, and E2NA to establish well drawdown characteristics and appropriate test flow rates. These three wells were selected as being representative of hydrogeological conditions in the northern (E14NC), southeastern (E13NB), and southwestern portions (E2NA) of the Facility.

The tests were conducted using a variable speed two-inch Grundfos submersible pump to extract groundwater from each of the three wells. Resulting water levels were then measured at adjacent monitoring wells/piezometers using the Hermit 2000 data logger.

Produced water was initially transferred into a 55-gallon drum to facilitate the determination of flow rate measurements. A pressure transducer was installed near the bottom of the drum to measure the water column height in the drum (and associated volume) simultaneously with the water level readings from each extraction well/piezometer pair. These automated level measurements within the drum were utilized to calculate flowrates throughout each test.

Water from the drum was then automatically transferred to the Facility's groundwater treatment system through the use of a level sensor that was installed on the sidewall of the drum.

5.9.3 Constant Flow Pump Tests

Constant flow pump tests were then conducted on wells E14NC, E13NB, and E2NA to acquire additional hydrogeologic data about the saturated zone. For the purposes of these pump tests, E14NC was pumped at a rate of 0.67 gallons per minute (gpm), E13NB was pumped at a rate of 0.40 gpm, and E2NA was pumped at a rate of 1.44 gpm. The well-specific flowrates were established using the results of the previously completed step tests.

Water level and flowrate measurements for the constant flow pump tests were acquired in a manner similar to the step test procedures previously described in Section 5.9.2.

The duration of each constant flow pump test was determined in the field based upon acquired water level data for each extraction well and its associated piezometer. The pump tests for E2NA, E13NB, and E14NC were conducted for 1.75 days, 1.79 days, 0.97 day, respectively.

5.9.4 Acquisition of Follow-up Water Level Data

Following the completion of the pump testing activities, the Facility's groundwater extraction system was re-activated.

Upon re-activation, water level data were collected at fifteen minute intervals for an additional one-week period from transducers at monitoring wells RFIMW-6, RFIMW-8, RFIMW-11, RFIMW-18, RFIMW-20, and the two Detroit River monitoring locations designated River N and River S.
In addition, water level measurements were recorded three times per day from wells E13NB, PE13NB, E10NB, PE10NB, E14NC, PE14NC, E2NA, PE2NA, RFIMW-25, RFIMW-26, and P34N. Pump test results are presented in Section 7.0.

6.0 ADDITIONAL PHASE I RFI ACTIVITIES

This section summarizes additional non-field related activities which were conducted as part of the Phase I RFI. These supplemental activities included: validation of the field-related and analytical laboratory data, development of a geographic information system (GIS) for the Facility, acquisition/evaluation of pertinent existing data for sediments in the Trenton Channel, and completion of a preliminary risk assessment.

6.1 Data Validation

Data validation procedures were completed for various field-related activities. Notebooks, equipment calibration logs, and other field-related data were reviewed by the RFI Field Manager in accordance with QAPP-specified protocol. Due to the viscous nature of the AOC 4 tar samples, lack of soil content, and presence of volatile organic constituents, geotechnical analyses including moisture content, compaction, and strength could not be performed. Quarterly monitoring data and other field-related data were reviewed by the RFI Consultant PM.

Data validation procedures were also completed for laboratory-related activities. Environmental Standards, Inc. (ESI) performed data validation for 100% of the Quanterra-generated analytical data. Upon fulfilling the data validation requirements for each data set, ESI subsequently prepared and assembled a written quality assurance (QA) review document to describe/summarize their findings. These QA documents are presented under separate cover as Appendix D.

6.2 Geographic Information System Development

A geographic information system (GIS) was developed to geographically summarize data acquired from the Phase I RFI. Although the GIS was not a requirement of the RFI Workplan, BASF decided to organize and present the various types of RFI data using this format. In addition to fulfilling the presentation requirements for this Report, BASF will continue to utilize the established GIS as a tool for management, analysis, and presentation of the collected RFI data.

6.3 Detroit River Sediment Study

Focused research and evaluation tasks were conducted to evaluate sediment quality in the Trenton Channel adjacent to the Facility. During this process, a computerized search was performed to identify and inventory pertinent documentation of sediment and water quality data in the vicinity of the Facility. Various other resources were evaluated as part of this study including: numerous reports summarizing sediment quality within the Trenton Channel/Detroit River, soil survey maps, and telephone contacts with appropriate State and Federal agency representatives (MDNR, U.S. Army Corps of Engineers, U.S. Fish and Wildlife, et al).

In addition, potential human and ecological risk scenarios were developed/evaluated as part of the preliminary risk assessment described in the section below.

6.4 Preliminary Risk Assessment

Preliminary risk assessment tasks were completed to evaluate the potential magnitude of risk to human health and the environment associated with the actual or potential release of constituents from the Facility. The preliminary risk assessment provided an initial evaluation of the potential risk associated with each SWMU and AOC. Furthermore, this effort helped to identify areas at the Facility which may require additional investigation in the future.

Supplemental risk assessment tasks were completed in October 1998 to incorporate analytical results from the GTI Toluene Remediation Investigation Report (TRIP) for AOC 1 and AOC 8.

The risk assessment is classified as "preliminary" at this time because additional investigative work may potentially be required at one or more of the SWMUs/AOCs. Documentation of the preliminary risk assessment and associated calculations is provided in Section 8.0, Appendix F, and Appendix G of this Phase I RFI Report.

7.0 PHASE I RFI RESULTS

This section discusses the geological, hydrogeological, geophysical survey, and chemical analysis results of the Phase I RFI which served to characterize the nature and extent of hazardous waste/constituent releases at the Facility. The soil and groundwater results may also serve to define and develop additional investigation approaches necessary to attain the RFI objectives as described in Section 4.0.

7.1 Geological and Hydrogeological Results

Geological and hydrogeological information was acquired through an evaluation of the soil boring logs, associated geological cross-sections, aquifer slug tests, and aquifer pump tests that were conducted at the Facility. Copies of the soil boring and monitoring well logs are provided in Appendix B. Aquifer test evaluation data and associated plots are provided in Appendix C. Field parameter and groundwater elevation summary tables are provided in Appendix E. Results from each evaluation method are summarized below.

7.1.1 Results Derived from Soil Boring Data

at least 70 samples

7.1.1.1 Background Soil Borings

On-site background soil samples were described and characterized in accordance with the USC system. Data for background soil borings RFIMW-24, RFIMW-25, RFIMW-26, RFIMW-27, RFIMW-28, and RFIMW-29 along the western corridor of the Facility indicate the presence of the Native Sand Unit and general absence of the Fill Unit. Background soil boring data confirmed the presence of the first three of four stratigraphic units beneath the Facility.

7.1.1.2 Facility Soil Borings and Soil Punches

Facility soil borings were completed as part of the Phase I RFI to provide site-specific stratigraphic and hydrogeologic data. Soil boring data confirmed the presence of four stratigraphic units beneath the Facility. As previously described in Section 3.0, these four units are defined in descending order as the 1) Fill Unit, 2) Clay and Peat Unit, 3) Native Sand Unit, and 4) Lacustrine Clay Unit.

<u>Fill Unit</u>

Soil boring data indicate that a heterogeneous Fill Unit overlies the native materials at the Facility. Fill material generally consists of a mixture of bi-products from past manufacturing operations, rubble from past Facility demolition activities, and natural native materials. Categories specifically encountered include: 1) clinker gravel with coal, coke, tar, gravel and sand, 2) distillate blow-off

(DBO); 3) gravelly, mottled clay; or 4) construction debris including large blocks of concrete, brick, and pipe. Fill thickness varied throughout the Facility, but typically ranged from 6-15 ft. Fill thickness variations across the Facility are displayed in Figure 7-6 in the form of an isopach map.

A thick deposit of fill was identified in the eastern portion of the Facility to the northeast of extraction well E13NB. This localized deposit generally coincides with a topographic high area of the Facility. As typified by the boring log for monitoring well RFIMW-7, the fill in this area appears to consist primarily of DBO. This area of thick DBO deposits (Central Area) effectively enables the Facility to be separated into three general horizontally-defined fill areas (i.e., Central Area, South Area, and North Area) in recognition of the hydraulic response of the fill material in each specific area.

In the southern part of the Facility in the vicinity of AOC 6, soil punch data indicates that the fill material primarily consists of clinker gravel, coal, or coke mixed with sand and mottled clay. Laterally isolated DBO deposits were also encountered in this area, which was classified as the South Area.

Gravelly fill material was also identified as the dominant lithology to the north of the extensive DBO deposits, as typified in the boring logs for monitoring wells RFIMW-2 and RFIMW-3. This area was designated as the North Area. Isolated DBO deposits were still periodically encountered in the North Area, as evidenced by the log of monitoring well RFIMW-1.

In summary, geological characteristics of the fill materials facilitated the classification of three general fill areas at the Facility (Central Area, South Area, and North Area). Subsequent well siting/selection criteria were established for the aquifer pump tests to ensure representative coverage for each of these three areas.

<u>Clay and Peat Unit</u>

The next recognized sequence at the Facility is a silty, organic-rich clay and interbedded peat sequence (Clay and Peat Unit). Unit thickness generally ranges from 0-4 ft. across the Facility, although in selected locations it attains a thickness of up to 9 ft. Soil boring data indicate that the thickness of the unit increases along the southeastern boundary of the Facility. This trend corresponds with the occurrence of a thicker underlying sand layer and a pronounced low in the surface of the Lacustrine Clay Unit. However, other areas of increased thickness are not apparently related to the characteristics of the underlying sand unit. Furthermore, the Clay and Peat Unit appears to be absent in some areas of the Facility. Although the thickness of the Clay and Peat Unit is variable, the material properties of the unit appear to remain relatively constant. Figure 7-7 displays an isopach map of this unit which supports this conclusion.

Native Sand Unit

Soil boring results identified the presence of a fine-grained, well-sorted, silty sand (Native Sand Unit) beneath the previously defined units. Unit thickness varies throughout the Facility, but typically ranges from 4-12 ft. Thickness variations across the Facility are portrayed as an isopach map in Figure 7-8.

The Native Sand Unit is generally thickest to the southeast and through the center portion of the Facility, demonstrating the same north-south linearity that is present on the surface of the underlying clay. Increasing thicknesses of this unit generally correspond with lows on the underlying clay surface. Where the elevation of the clay surface rises sufficiently, the unit thins or pinches out.

The Native Sand Unit appears to be a channel fill deposit of the pre-historic Detroit River. This sand unit is relatively uniform in grain size and sorting, reflecting the load capacity of the moving water from which it was deposited.

Lacustrine Clay Unit

Soil boring results verified the presence of the Lacustrine Clay Unit beneath the Facility. This unit was generally encountered between 20 - 30 ft bls. Based on interpretations of both site-specific RFI boring results and regional geological information, the Lacustrine Clay Unit is expected to be relatively uniform and continuous beneath the Facility and immediately surrounding area. As such, it serves as an effective lower confining layer beneath the Facility.

Based on interpretations of soil boring logs from the Facility, it appears that the surface of the Lacustrine Clay Unit generally dips toward the east. The unit also exhibits a distinct north-south oriented low that is apparent beneath the central portion of the Facility, as well as AOC 6. Further to the east, the rate of dip along this surface increases dramatically in the area of monitoring wells RFIMW-9 and RFIMW-11. Elevation contours for the top surface of the Lacustrine Clay Unit are displayed in Figure 7-9.

7.1.1.3 Geological Cross-Sections

Based on the available Phase I RFI soil boring data, four geological cross-sections were prepared to illustrate subsurface characteristics at the Facility. The cross-sections depict the relationships between the various geologic units as well as the anthropogenic fill material.

Relative locations of the cross-sections are indicated in Figure 7-1. Geological cross-section A-A' (north-south) is presented as Figure 7-2. Cross-sections B-B', C-C', and D-D' (each west-east) are presented as Figures 7-3, 7-4, and 7-5, respectively.

Geologic Interpretations Regarding the Fill Unit

The cross-sections indicate that the Fill Unit at the Facility extends from at/near the surface to a depth of 6 - 15 ft bls. While the filling appears to generally be random in nature, the following patterns are apparent from a review of the cross-sections:

- The fill beneath the north central portion of the Facility from RFIMW-13 extending south to just south of the B-B' section line is generally composed of gravel, bricks, and earthen fill. The Clay and Peat Unit is generally more pronounced in this area, as well.
- The presence of DBO is generally more common in the central portion of the Facility from just north of soil boring PE10NB to the south of RFIMW-27.
- There are apparent isolated occurrences of DBO in other areas. However, the thickness and distribution of DBO is not as pronounced as in the central portion of the Facility.
- The southern portion of the Facility is generally characterized by the presence of fill rich in cinders. Cross-section A-A' illustrates the transitions between these areas.
- The west to east cross-sections B-B', C-C', and D-D' show the general character of the north-central, central, and southern areas, respectively.

Geologic Interpretations Regarding the Clay and Peat Unit

The cross-sections indicate that the Clay and Peat Unit which underlies the Fill Unit typically exhibits a thickness of 0 - 4 feet. The following patterns are apparent from a review of the cross-sections:

- The Clay and Peat Unit is widely distributed across the Facility; however, it was not observed at every boring location. The absence of the Clay and Peat Unit may be attributed to natural non-deposition in areas of faster moving minor channels of the river, or the clay and peat may have been removed from localized areas prior to their development.
- The west to east cross-sections B-B' and D-D' indicate that the thickness of the Clay and Peat Unit generally increases moving eastward across the Facility. This trend corresponds with a thicker underlying sand layer and a pronounced low in the surface of the Lacustrine Clay Unit.

Geologic Interpretations Regarding the Native Sand Unit

The cross-sections indicate that the Native Sand Unit which underlies the Clay and Peat Unit typically exhibits a thickness of 4 - 12 feet. The following patterns are apparent from a review of the cross-sections:

- The cross-sections indicate that this unit is ubiquitous beneath the Facility. However, based on the boring data for RFIMW-18 and RFIMW-19, the Native Sand Unit is projected to be absent along the eastern corridor of the Facility.

- The sand is relatively homogeneous and tends to be light brown in its upper portions and turns to gray lower down, just above the Lacustrine Unit (e.g. borings P-27-N and PE14NC in cross-section A-A').
- At various locations, the approximate upper 1-ft interval of this unit is dark brown or black (e.g. RFIMW-13 and P-39-N in cross-section A-A'). This coloring is attributable to staining from the overlying sediments or materials.

Geologic Interpretations Regarding the Lacustrine Clay Unit

The following patterns are apparent from a review of the cross-sections:

- The cross-sections indicate that the entire Facility is underlain by an apparently continuous, homogeneous lacustrine clay of undetermined total thickness.
- The Lacustrine Clay Unit is encountered between 20 - 30 ft bls.
- The cross-sections illustrate the presence of a distinct north-south oriented low that is apparent beneath the central and southern portions of the Facility. This low consists of a 2 - 6 ft depression (e.g. borings RFIMW-15 in cross-section B-B' and PE10NB in cross-section C-C'). However, further to the east, a rise in the clay surface elevation effectively creates a "clay ridge" along the shoreline to the Detroit River.

Hydrogeologic Interpretations

The following conclusions were based from a review of the cross-sections:

- Based on the elevation surfaces noted for the Lacustrine Clay Unit, a north-south trending channel which parallels the current river channel is apparently incised into the clay which parallels the current river channel. This fluvial channel creates a natural sump to assist in the retention of constituents which may have been released into the lower portion of the unit.
- This fluvial channel effectively creates a localized "high elevation" ridge on the Lacustrine Clay Unit surface parallel to the river and a corresponding thinning in the Native Sand Unit. In some instances, the Native Sand Unit pinches out over the clay high altogether. This condition effectively results in the absence of a migration pathway and acts as an impediment to easterly flow. This high is demonstrated in cross-section D-D' of Figure 7-5.
- Present over a significant portion of the Facility, the Clay and Peat Unit enhances the controlling capabilities of the groundwater extraction system and likely augments the beneficial effects of the pinchout of the Native Sand Unit. The low vertical permeability of this Clay and Peat Unit provides a degree of vertical hydraulic separation from the overlying Fill Unit.

7.1.1.4 SWMU/AOC-Specific Geological Results

SWMU H

While the fill material in SWMU H is heterogenic, several generalizations can be drawn regarding the stratigraphy of this unit. Several feet of material near the ground surface typically consist of sandy gravelly clay. Beneath the surficial clay, a sequence of black slag gravel and coarse-grained sand interbedded with clay-rich layers was often encountered. This sequence is typically saturated and appears to be relatively permeable. FID readings were often noted to increase dramatically in the saturated sediment.

Beneath the gravel sequence, many of the borings failed to recover any material within the spoon. This occurrence is likely due to very high liquid content and low compressive strength of the clay-like material which was noted to cover the outside of the spoons upon recovery. The thickness of the soft clay-like material was variable, possibly indicating that it acts as a channel fill material. Underlying the fill material, occurrences of peat overlying native fine-grained sand were noted. FID readings were often noted to increase with the occurrence of peat, indicating that it may be absorbing volatile organic constituents.

7.1.2 Hydrogeologic Testing Results

Results from the aquifer slug tests and pump tests were utilized to develop various hydrogeologic property values (e.g. soil permeability, transmissivity, storativity) for the saturated zone beneath the Facility. Test results were also used to evaluate baseline groundwater flow characteristics; assess inter-relationships between monitoring wells, flow impediments, and the river; and develop preliminary capture zones for the groundwater extraction system. Derived results from these tests are provided in Sections 7.1.2.1 thru 7.1.2.4 to support subsequent characterizations of groundwater flow beneath the Facility. Copies of the slug/pump testing data and results are included in Appendix C.

7.1.2.1 Slug Test Results

Slug tests were conducted at monitoring wells RFIMW-9 and RFIMW-19 to evaluate permeability in the vicinity of these wells. Based on the method of Bower-Rice (1976), time-drawdown data were generated to determine permeability values in the immediate vicinity of each monitoring well.

Slug test plots of displacement versus time are provided in Figures C-1 through C-4 of Appendix C. The following estimates were derived:

- Soil permeability in the immediate vicinity of RFIMW-9 is estimated at 0.0179 - 0.0233 feet/minute.
- Soil permeability in the immediate vicinity of RFIMW-19 is estimated at 0.0006 - 0.0013 feet/minute.

7.1.2.2 Groundwater Elevation Data Acquired for Pump Tests

Groundwater elevation data were acquired prior to, during, and after the pump tests. Pre-test data were obtained to evaluate groundwater flow directions/gradients without the influence of the groundwater extraction system. During the tests, additional water level data were acquired to identify flow inter-relationships between monitoring wells, impediments, and the river. Post-test data were obtained to evaluate groundwater flow directions/gradients. These data sets and the associated results are described below.

Pre-Test and Post-Test Groundwater Elevation Data

Prior to initiation of the pump tests, the extraction system was shut down to establish equilibration of the potentiometric surface. Selected wells were then periodically monitored over several days to verify equilibration. In addition, two monitoring stations were installed within the Detroit River (designated River N and River S) to assist in the evaluation process.

Using groundwater elevation data for the afternoons of July 14, July 19, July 21, and July 22, 1997, potentiometric surface differences were contoured to evaluate equilibration of the hydrogeologic system prior to testing (See Figures C-5, C-6, C-7). The difference plot between July 21 and July 22 indicates little change and was thus used to verify equilibration of the potentiometric surface.

All of these surfaces display that the general direction of groundwater flow at the Facility is toward the west-southwest. The gradient is generally steeper in the northern half of the Facility than in the southern half. Elevation data acquired from monitoring well RFIMW-11 and monitoring station River S, as well as from monitoring well RFIMW-8 and monitoring station River N, indicate local gradients toward the Detroit River.

Using post-test groundwater elevation data for the afternoons of August 6, August 8, and August 10, 1997, potentiometric surface differences were similarly contoured to evaluate equilibration of the hydrogeologic system (See Figures C-8, C-9). The difference map between August 8 and August 10 indicates little change and was thus used to verify equilibration of the potentiometric surface. Elevation data acquired from monitoring well RFIMW-11 and monitoring station River S, as well as from monitoring well RFIMW-8 and monitoring station River N, indicate consistent local gradients toward the Detroit River.

Separation of water-bearing units (as a result of a lower permeability unit) can result in distinctly different static water levels in the two units at a given location. For example, water elevations in some of the Papadopulos (P series) wells (e.g. July 1996 static level for P-16-N for example) appear higher than expected when compared to other wells screened in the Native Sand Unit. This result is likely to be associated with the vertical separation effect of the Clay and Peat Unit. Thus, water level data collected during the RFI confirm the presence of a lower permeability confining unit.

Water Level Data Acquired during Pump Tests

Water level data acquired during the pump test activities were useful in characterizing groundwater flow at the Facility. These data were plotted in Figure 7-10 to illustrate the temporal variation of water levels for monitoring wells RFIMW-6, RFIMW-8, RFIMW-11, RFIMW-18, and RFIMW-20, as well as monitoring stations River N and River S.

The measured head at monitoring well RFIMW-6 (east central area along the shoreline) was consistent at approximately 3 inches higher than the adjacent river measurement (River N). This apparent gradient from RFIMW-6 to the river is greater than the corresponding gradients for either of the other two shoreline wells measured (RFIMW-8 or RFIMW-11). These data support the conclusion that the steel sheet piling system (in the vicinity of RFIMW-6) serves as an impediment to groundwater flow between the Facility and the river. However, the correlation coefficient between the available water level data for RFIMW-6 and the River N monitoring station is only 0.49 (a correlation coefficient of 1.0 indicates that one set of data corresponds perfectly with another data set). This relationship is similar to the connection between RFIMW-11 and River S (correlation coefficient of 0.53) where sheet piling is not present.

Data acquired from monitoring well RFIMW-20 (southeast area not immediately along the shoreline) were highly variable. Regular and nearly diurnal cyclic variations of 0.5 ft or less were prominent for the initial approximate 6.2 days (9,000 minutes) of the test. Dampening effects were noted from approximately 6.2 days to 15.3 days (22,000 minutes); more apparent cyclical variations then resumed until approximately 20.1 days (29,000 minutes). Water level changes at RFIMW-20 were noted to occur abruptly, e.g. the rate of change is very rapid creating a series of modified square waves rather than sinusoidal variations. Based on the wave type observed, these findings are not likely to be associated with naturally-occurring phenomena at the Facility. Furthermore, these cyclical variations at RFIMW-20 do not appear to correspond with observed variations for data from RFIMW-11 or the River S monitoring station.

Water level data acquired from monitoring well RFIMW-8 (east central area along the shoreline) were remarkable since they appeared to track incremental changes of the river level (e.g. level changes as small as several tenths of a foot and as short as one hour in duration). The correlation coefficient between the available water level data for RFIMW-8 and the River N monitoring station (test start-up until 24.2 days [34,875 minutes]) is 0.93. This correlation indicates the presence of a strong hydraulic connection between RFIMW-8 and the Detroit River.

Data acquired from RFIMW-18 (east central area not immediately along the shoreline) were unusually stable. This finding may be indicative of a hydraulic barrier in the vicinity of RFIMW-18. However, the stability of the water level data may also be associated with a transducer/cable mechanical failure.

Data Acquisition Limitations

Various minor field difficulties were encountered during the acquisition of water level data from the aquifer tests. The cable to monitoring well RFIMW-6 was severed by a ground hog; upon detection, the cable was spliced in the field. Several shifts in the average water levels were noted in the subsequent data from this well. Because of these shifts, data collected from RFIMW-6 after 11.6 days (16,725 minutes) were not evaluated.

In addition, 1) the cable for RFIMW-20 was observed to have been cut during the last week of the pumping test, and 2) the cable to the River N transducer was broken at a time of 24.2 days (34,875 minutes). Data evaluations were only performed for the time periods prior to the respective equipment mishaps/breakdowns.

7.1.2.3 Step Drawdown Test Results

Pump tests were conducted at three separate extraction wells to evaluate hydrogeologic conditions/properties associated with the three general areas previously described in Section 7.1.1. Extraction wells E14NC, E13NB, and E2NA were selected to represent the three general areas of fill material (e.g. North Area, Southeast Area, and Southwest Area). Testing data and analyses of the step tests are provided in Appendix C.

Using the method of Bierschenk (1964), well efficiency values were determined to evaluate head losses for each of the three tested extraction wells. The following results were acquired:

- The well efficiency of E14NC varies from 79% at a pumping rate of 0.1 gallons per minute (gpm) to 39% at a pumping rate of 0.67 gpm.
- The well efficiency of E13NB varies from 93% at a pumping rate of 0.1 gpm to 80% at the pump test flow rate of 0.4 gpm.
- The well efficiency of E2NA varies from 87% at a pumping rate of 0.1 gpm to 38% at the pump test flow rate of 1.4 gpm.

Because of the low flowrates encountered, the well efficiency values likely represent a combination of well losses and losses associated with the formation. The slope of pressure change in the staging barrel was averaged to determine the actual flow rates applied during the test. Based on the results of the step tests, constant flow rates were established and maintained during the constant flow pump tests of the three selected extraction wells.

North Area Pump Test

The test data from the pumping test of E14NC appear to fit a Papadopulos-Cooper curve (Papadopulos and Cooper, 1967) after the first five to ten minutes of the test. This curve was developed to account for the effects of wellbore storage, which can be significant at low flow rates. Data acquired during the first few minutes of the test are expected to be problematic because rapid changes in the water level during the early part of the test, and the low (0.25 gpm) flow rate created difficulties in maintaining constant flow rates. E14NC is screened from 15 - 20 ft bls (entirely in the Native Sand Unit). The following hydrogeologic values were determined for this area:

- Estimated transmissivity of the formation is 0.09369 ft^2/minute;
- Estimated storativity is 0.002375.

Southeast Area Pump Test

The test data from the pumping test of E13NB appear to fit a Papodopulos-Cooper curve with the exception of the data acquired during the first couple minutes of the test. E13NB is screened from 15 - 20 ft bls (entirely within the Native Sand and Clay and Peat Units). The following hydrogeologic values were determined for this area:

- Estimated transmissivity of the formation is 0.01981 ft^2/minute;
- Estimated storativity is 8.2114×10^{-6}.

Southwest Area Pump Test

The test data from the pumping test of E2NA appear to fit a Theis curve (Theis, 1935) with the exception of the data acquired after 400 minutes of testing. The Theis type curve is a graph of the expected head in a well versus time assuming that the well penetrates an extensive confined aquifer and that the aquifer is pumped at a constant rate. The higher pumping rate of E2NA relative to the previous tests may account for the reduced effect of casing storage in the early data. The data acquired after 400 minutes of testing appear to show the effects of a recharge boundary.

One possible interpretation would be to assume that the Clay and Peat Unit which overlies the Native Sand Unit, and which acts as a confining layer, may be thin in the vicinity of E2NA. This condition is indicated on the Isopach Map of Clay and Peat Unit (Figure 7-7). Well E2NA is screened from 14 - 24 ft bls (entirely in the Native Sand Unit). Four feet of peat is present above the sand at this location. The following hydrogeologic values were determined for this area:

- Estimated transmissivity of the formation is 0.02782 ft^2/minute;
- Estimated storativity is 0.001689.

Due to the presence of an aquitard to vertical flow (Clay and Peat Unit), groundwater flow at the Facility is likely separated into two distinct units. Only the lower of these two units was monitored during the Phase I RFI. The apparent groundwater flow toward the southwest is potentially attributable to vertical hydraulic separation.

7.1.2.4 Estimation of Capture Zones

Capture zone estimates were developed using a simple model developed by David Keith Todd (*Groundwater and Hydrology*, 1979). This method recognizes that the areal extent of a capture zone for a pumping well is a parabola, the geometry of which is described by the intersection of a cone (extraction well cone of depression) and a plane (the water table). Key method considerations include the assumption of a homogeneous aquifer of practically infinite extent, uniform gradient, and uniform transmissivity.

The width of the estimated capture zone is dependent on the local gradient. The local gradient was estimated using the potentiometric surface map for August 10, 1997 (See Figure C-10). Estimates of the upgradient capture zone parabola (in plan view) are provided in Figures C-11, C-12, and C-13.

Capture zones developed for the groundwater extraction system at the Facility indicated that most, if not all, of the groundwater flowing onto the Facility from the western boundary would eventually be drawn into the system's radius of influence. The capture zones would also extend downgradient far enough to cover most of the Facility in the downgradient direction.

For the capture zone determinations previously described, the saturated unit at the Facility was assumed to consist of a single unit without any areally extensive barriers to vertical flow. As previously noted in Section 7.1.2.3, there is evidence to suggest that this is not the case. The confining nature of this Clay and Peat Unit provides a degree of vertical hydraulic separation from the overlying Fill Unit.

The most significant limitation of this evaluation method lies in its failure to address meteoric recharge (e.g. rainfall at the Facility). Meteoric recharge to the area reduces the extraction system's area of influence, thus raising the potential for off-site migration of groundwater.

Furthermore, the model assumptions of homogeneity and uniformity are incompatible with actual subsurface conditions at the Facility. As a result, site-specific hydrogeological complexities prohibited the development of quantitative values for the capture zone radii. However, evaluations were nonetheless performed to provide a preliminary estimate of system efficiency and establish a comparative baseline for future evaluations.

7.1.3 Quarterly Groundwater Elevation Data

Groundwater level measurements were acquired to evaluate the direction and flowrate of shallow groundwater beneath the Facility. Static water level data were collected from the fifteen perimeter monitoring wells during quarterly sampling events in September 1996, December 1996, March 1997, and June 1997. Potentiometric surface maps for these four monitoring events are displayed in Figures 7-11, 7-12, 7-13, and 7-14. Groundwater level measurements for each of the four quarterly monitoring events are provided in Tables E-7 through E-10 of Appendix E.

All four surfaces demonstrate general flow towards the Detroit River in the northern half of the Facility with relatively steep gradients. The four surfaces also indicate potential flow from the Detroit River to the southern half of the Facility with very low gradients.

Northern and Southeastern Areas

For the northern and southeastern areas of the Facility, potentiometric data indicate the presence of a low flow gradient toward the Detroit River. However, Papadopulos (1984) indicated that the Detroit River potentially acts to recharge groundwater in the southeast portion of the Facility during concurrently high stages of the river and low stages of the water table. This scenario is most likely to occur during the summer months of June, July, August, and possibly September. Water level measurements acquired for RFIMW-11 and the Detroit River on August 10, 1997 did not substantiate this situation, but rather indicated a very gentle gradient toward the river.

Southwestern Area

For the southwestern area of the Facility, potentiometric data indicate the presence of a low flow gradient toward the southwest. Furthermore, potentiometric data indicate the presence of a groundwater divide which separates southwesterly and southeasterly groundwater flow in the southern one-third of the Facility.

7.1.4 Evaluation of Groundwater Extraction System Efficiency

Results from the various groundwater monitoring/testing activities previously described were assimilated to assess the efficiency of the groundwater extraction system. The utilized data, underlying assumptions, resultant conclusions, and associated limitations for this evaluation process are described below.

As part of the evaluation activities following completion of the pump tests, groundwater elevation data were acquired on August 10, 1997 (See Figure C-10 [Potentiometric Surface for August 10, 1997]). These data were collected approximately one week after the groundwater extraction system had been fully re-started. Water level data acquired from monitoring well RFIMW-8 and River N indicate that the gradient was gently toward the river at that time. The gradient from monitoring well RFIMW-11 to River S was essentially flat.

The potentiometric surface generated from the data acquired on August 10, 1997 indicates that significant areas of the Facility are not controlled by the extraction wells for which static measurements were taken (E2NA, E10NB, E13NB, and E14NC). However, this data set is not inclusive of all operational extraction wells, nor does it include all of the existing monitoring wells. To provide a more accurate representation of the groundwater flow characteristics, an additional potentiometric surface map (Figure 7-15) was developed as described below.

As a first step in developing a more representative approximation of the potentiometric surface on that date, depth to water in the remaining 11 extraction wells (e.g. E1NA, E3NA, E4NA, E5NB, E6NB, E7NB, E8NB, E9NB, E11NB, E12NB, and E15NC) was estimated utilizing depths to water reported in 1996. Because the design of the extraction system keeps the water levels near the base of the extraction tube, these estimates are considered reasonable.

The extraction well data were then kriged utilizing an exponential distance weighting function and a range of 50 feet. This is considered a conservative approach, since it will populate grid nodes greater than 15 feet from the extraction wells. As a result, depth to water at these locations will be greater than the 2-4 feet observed during the pump tests at the piezometers located immediately adjacent to the extraction wells.

Based on this "approximated scenario" which incorporates actual field data and conservative assumptions, Figure 7-15 was developed to provide a more accurate representation of groundwater flow characteristics at the Facility on August 10, 1997. Figure 7-15 indicates that a component of groundwater flow is likely discharging to the river. However, quantitative determination of the groundwater discharge cannot be rendered using these data.

Additionally, the extraction system appears to be most effective in the southern half of the Facility where a majority of the horizontal hydraulic gradients are essentially flat or slightly toward the interior of the Facility. In contrast, horizontal gradients toward the river along the northern portion of the Facility indicate reasonable potential for off-site migration in these areas.

Based on an evaluation of the potentiometric surface displayed in Figure 7-15, the presence of a groundwater "divide" is indicated roughly parallel to the river along the eastern side of the Facility. The approximate location of this groundwater divide is displayed in Figure 7-15. Although its location cannot be precisely defined at this time, this divide further supports the conclusion that a component of groundwater flow is likely discharging to the river.

7.2 Geophysical Survey Results

Geophysical survey results are provided below for the surveys completed at AOC 4 and AOC 6.

7.2.1 AOC 4 Resistivity Survey Results

The electrical resistivity survey was completed at AOC 4 to evaluate the horizontal and vertical extent of the tar pit below the crushed limestone surface material. Three transects were evaluated as part of this survey at AOC 4. The locations of these transect lines A-A+, B-B+, and C-C+ are depicted in Figure 7-23. The resulting 2-dimensional resistivity plots are presented in Figure 7-16. It should be noted that the scale units for these profiles are displayed in "meters" and the color shading of the relative resistivity measurements varies between figures.

Soil boring logs along the perimeter of AOC 4 reflect a complex geological pattern consisting of interbedded layers of gravel fill, tar, coke and coal slag, DBO, sand, and clay. Generally, unsaturated coarse materials (e.g. sand, gravel, fill) would exhibit higher relative resistivities than clay and saturated sediments. For the purposes of this survey, the tar material was assumed to exhibit an extremely high resistivity. Therefore, the areas on the profiles depicting high resistivity values are more likely to represent tar deposits than other areas.

The dark purple areas displayed for transects A-A+ and C-C+ are likely to be representative of tar deposits. The vertical extent of the tar material appears to extend to a maximum depth of approximately 15 ft bls. The areas of maximum tar depth are noted toward the interior portions of AOC 4; the tar depths generally appear to taper off toward the edges.

The A-A+ profile indicates that the tar deposit terminates prior to the southern endpoint of the transect (point A) and does not extend to the road. The A-A+ and C-C+ profiles also indicate that the tar deposit may potentially extend to the east beyond points A+ and C+. This finding is supported by the observed presence of tar in soil borings SP01, -02, -03, -04, -13, and -14.

One area of high resistivity within the A-A+ profile is considered an anomaly. Because of the significant depth at which it is displayed (approximately 9 meters bls [30 ft bls]), this darker area is likely to be associated with a material other than tar.

Additionally, the dark purple areas indicated within the B-B+ profile are likely to be representative of unsaturated fill materials (as opposed to tar deposits) because the observed resistivities on the B-B+ profile are two orders-of-magnitude less than the A-A+ and C-C+ "tar-containing" profiles. Based on this deduction, the tar deposit is apparently confined to the east of the B-B+ profile.

7.2.2 AOC 6 Terrain Conductivity Survey Results

The electrical conductivity survey was completed at AOC 6 to evaluate the potential presence and extent of any tar deposits beneath AOC 6. Published data regarding the conductivity of tar is not available, however, tar is a poor conductor and would be expected to exhibit extremely low conductivity values.

The measured conductivity values ranged from 100 mmhos/meter to greater than 700 mmhos/meter. These values indicate that the fluid within the shallow saturated sediments is highly conductive. For this reason, the electromagnetic "signature" of the geologic materials was effectively obscured in AOC 6. Determination of the presence or absence of tar-like materials was inconclusive because of this effect.

An area of consistently lower conductivity values (100 to 300 mmhos/m) was noted along a line from the southwest corner to the northeast corner of AOC 6. This anomaly is consistent with a local topographic high. Therefore, the anomaly may be attributable to an increase in the thickness of the unsaturated sediments.

7.3 Analytical Results for Soil Sampling

Soil sampling results for the Phase I RFI are provided below for each of the five SWMUs, four AOCs, and on-site background locations. Analytical soil concentrations were compared with PSALs to delineate the extent of releases to soil at the Facility. The analytical laboratory data were assessed and validated based upon a review of standard quality control criteria established by the QAPP. Copies of the data validation reports and the associated analytical data are provided under separate cover as Appendix D.

7.3.1 Analytical Results for Background Soils

A total of ten soil samples were collected from the five background soil borings (which were subsequently completed as background monitoring wells). Five of the samples represented fill material, while the other five constituted sand materials. Samples were analyzed for 40 CFR 264 Appendix IX constituents. Analytical results for the background fill and background sand samples are summarized in Tables 7-1 and 7-2, respectively. Laboratory analytical results for constituents detected in at least one background soil sample were statistically analyzed to determine the concentrations of the various constituents that are representative of site-specific background conditions at each soil horizon.

Quantitation limits for the various SVOC and metals constituents differed slightly between the background fill and sand media due to inherent variability of the soil matrices. However, quantitation limits for the background fill and sand samples were typically within an acceptable 15% of one another and were not substantially different.

Site-specific background values were derived for constituents detected in background soil samples based on the mean of the background concentrations for each soil horizon. Tables 7-1 and 7-2 provide a summary of the calculated background soil concentrations.

As previously stated in Section 4.0, the background soil values for detected constituents were compared with the MDEQ GSI-based action levels to yield appropriate PSAL values. The selected PSALs were then compared with analytical data from investigative samples collected during the Phase I RFI to delineate the extent of any releases to soil at a particular sampling location.

7.3.2 Analytical Results for SWMU E

Analytical results for SWMU E were utilized to test the Polyols Pond sediments for RCRA hazardous characteristics.

Four sediments samples were acquired from SWMU E (two samples from each side pond) and submitted for chemical analysis to evaluate potential hazardous waste characteristics of the material.

None of the four sediment samples from SWMU E exhibited any characteristics of a RCRA hazardous waste. As a result, none of the COCs at SWMU E were retained for evaluation in the preliminary risk assessment.

7.3.3 Analytical Results for SWMU F

Analytical results for SWMU F were utilized to 1) characterize the nature of any constituent concentrations in deposited subsurface materials, and 2) assess the potential spontaneous combustibility of the spent Britesorb filter cake deposited in this area.

Forty seven perimeter borings and thirty four interior borings were advanced within SWMU F. Soil samples were collected from ten of the 34 interior borings for chemical analysis to identify any potential releases from this area. Since areas with 2-ft filter cake intervals were not encountered, sample collection criteria were modified to preclude this QAPP-based requirement. Boring locations are provided in Figures 7-17 and 7-18. Analytical results for constituents detected in soil samples from this unit are summarized in Table 7-3.

Six VOC constituents including toluene, acetone, 1,2-dichloropropane, xylenes (m and p), benzene, and methyl ethyl ketone were detected in samples acquired from SWMU F. A minimum of one VOC constituent was detected in each of the ten borings sampled from this area. The highest VOC concentrations were detected for five soil boring locations (SP01, SP03, SP04, SP06, and SP07) collected within the southeastern quadrant of SWMU F. Soil sample SP03 exhibited the highest toluene and 1,2-dichloropropane concentrations of 110 ppm and 70 ppm, respectively. Soil sample SP07 exhibited the highest acetone concentration of 190 ppm. Soil samples from SP09 and SP11 also contained 56 ppm and 28 ppm acetone, respectively.

Soil samples from five (SP01, -03, -04, -06, and 07) of the ten borings sampled within SWMU F contained concentrations which exceeded the preliminary site-specific action level (PSAL) for toluene. In addition, soil samples from SP03 (benzene, 1,2-dichloropropane), SP04 (1,2-dichloropropane) and SP06 (1,2-dichloropropane) contained constituent concentrations which exceeded VOC PSALs in this area.

Twenty six semi-volatile organic (SVOC) constituents were detected in the ten borings sampled in SWMU F. The highest SVOC concentrations were detected for soil samples collected along the eastern and southern boundaries of SWMU F including SP07 (22 ppm 2,4-dimethylphenol, 20 ppm 3-methylphenol/4-methylphenol), SP06 (21 ppm benzyl alcohol, 15 ppm di-n-octyl phthalate, 7.6 ppm bis(2-chloroisopropyl) ether [BCE]), SP03 (28 ppm BCE), and SP04 (15 ppm BCE). Soil sample SP08 exhibited significantly lower SVOC concentrations including 4.5 ppm fluoranthene, 6 ppm phenanthrene, 2.9 ppm pyrene, 1.3 ppm anthracene, and 1.3 ppm benzo(a)anthracene. Other soil samples from SWMU F exhibited SVOC levels which were similar to or less than sample SP08 levels.

Soil samples from three (SP03, -04, and -06) of the ten borings sampled within SWMU F contained concentrations which exceeded the PSAL for BCE. Eleven SVOC constituents from soil sample SP07 and four SVOC constituents from soil sample SP08 exceeded their respective PSALs. Fourteen (14) SVOC constituents exceeded PSALs (benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, benzyl alcohol, BCE, chrysene, 2,4-dimethylphenol, 2-methylnaphthalene, 2-methylphenol, 4-methylphenol, pentachlorophenol, and phenanthrene).

Two pesticide/PCB constituents were detected in two of the ten soil borings sampled in SWMU F. Aroclor 1254 was detected at a concentration of 2.8 ppm in sample SP07 and 4,4'-DDE was detected at a concentration of 7.8 ppb in sample SP18. These soil borings were completed along the southern and eastern portions of SWMU F, respectively. These constituent concentrations exceeded their associated PSALs.

Fifteen metal constituents were detected for samples acquired from SWMU F. Metals constituents were detected at levels exceeding the associated PSALs in seven of the ten borings sampled in SWMU F. The highest metal concentrations were detected for soil sample SP07 collected along the south side of the area. Soil samples SP07 (16 ppm antimony, 62 ppm arsenic, 491 ppm barium, 7.3 ppm cadmium, 130 ppm chromium, 40.5 ppm cobalt, 7,710 ppm copper, 876 ppm lead, 21.1 ppm mercury, 170 ppm nickel, 6.3 ppm selenium, 10.5 ppm silver, and 1,000 ppm zinc), SP06 (12.2 ppm arsenic, 62.8 ppm copper, 64.3 ppm lead, and 2.2 ppm mercury), SP09 (63.9 ppm arsenic and 1.2 ppm mercury), SP02 (22.9 ppm arsenic and 23.4 ppm nickel), SP03 (14.7 ppm arsenic and 3.5 ppm mercury), SP08 (28.4 ppm arsenic), and SP01 (12.3 ppm arsenic) contained metal concentrations which exceeded their respective PSALs. PSAL exceedances for eight metal constituents (antimony, barium, cadmium, chromium, cobalt, selenium, silver, and zinc) were solely attributable to soil sample SP07.

Cyanide was detected in eight of the ten samples acquired from SWMU F. The highest total cyanide concentrations were detected for soil samples SP06 (5.1 ppm) and SP07 (4.9 ppm) collected along the southern portion of the area. Total cyanide results were then compared to the more conservative PSAL for amenable cyanide, since a value for total cyanide was not available. Eight of the samples from SWMU F contained constituent concentrations which exceeded the PSAL for amenable cyanide.

The 80% upper confidence limit (UCL) values for the SWMU F samples were compared to the constituent-specific PSAL values to evaluate the presence of significant constituent concentrations. Table 7-4 displays a comparison of the 80% UCL and the PSAL values.

As a result, the following constituents of concern (COCs) at SWMU F were retained for evaluation in the preliminary risk assessment:

- VOCs (4): benzene, 1,2-dichloropropane, toluene, and m- and p-xylenes;
- SVOCs (17): acenaphthene, naphthalene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, benzyl alcohol, BCE, chrysene, 2,4-dimethylphenol, indeno(1,2,3-cd)pyrene, 2-methylnaphthalene, 2-methylphenol, 4-methylphenol, pentachlorophenol, and phenanthrene;
- Pesticides/PCBs (2): Aroclor 1254, 4,4'-DDE;
- Metals (9): antimony, arsenic, chromium, cobalt, copper, lead, mercury, nickel, and zinc; and,
- Other Inorganics (1): cyanide.

Twelve samples from SWMU F were also submitted to the on-site BASF laboratory for evaluation of spontaneous combustibility. All twelve of the samples yielded a positive result for spontaneous combustibility.

7.3.4 Analytical Results for SWMU G

Analytical results for SWMU G were utilized to characterize the nature of any residual constituents in 40 CFR 264 Appendix IX that have potentially been released from staged debris at this area.

Ten surface soil grab samples were acquired from SWMU G utilizing a superimposed grid. Soil samples were collected for chemical analysis to identify any potential releases from debris that was staged in this area. Sampling locations are provided in Figure 7-19. Analytical results for surface soil samples collected from this unit are summarized in Table 7-5.

VOCs were not detected in any of the ten samples collected from SWMU G.

Twenty two (22) SVOC constituents were detected in the ten surface soil samples collected from SWMU G. The highest SVOC concentrations were detected for soil samples within the most interior portions of SWMU G including SWMUG-9 (6.1 ppm pyrene, 4.5 ppm benzo(b)fluoranthene, 3.8 ppm fluoranthene, 3.7 ppm benzo(a)pyrene, and 3.6 ppm chrysene), SWMUG-4 (1.4 ppm benzo(b)fluoranthene [estimated], 1.1 ppm pyrene [estimated], and 1.1 ppm chrysene [estimated]), and SWMUG-6 (1.6 ppm phenanthrene). Other soil samples from SWMU G exhibited similarly low or non-detected SVOC levels, primarily consisting of ubiquitous PAHs.

Soil samples from five of the ten samples collected from SWMU G contained concentrations which exceeded at least one SVOC PSAL. Thirteen SVOC constituents from soil sample SWMUG-9 and nine SVOC constituents from soil sample SWMUG-4 exceeded their respective PSALs. Thirteen SVOC constituents exceeded PSALs (acenaphthylene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, chrysene, dibenz(a,h)anthracene, indeno(1,2,3-c,d)pyrene, 2-methylnaphthalene, naphthalene, pentachlorophenol, and phenanthrene).

One PCB constituent was detected in five of the ten surface soil samples from SWMU G. Aroclor 1260 was detected in sample SWMUG-2 at a concentration of 0.37 ppm. The same constituent was also detected at estimated concentrations of 1.1 ppm, 1.0 ppm, 0.43 ppm, and 0.37 ppm in samples SWMUG-4, 9, 6, and 5, respectively. No significance could be assigned to the spatial distribution of these sampling locations. These constituent concentrations exceeded the associated PSAL.

Thirteen metal constituents were detected for surface samples acquired from SWMU G. Metals constituents were detected at levels exceeding the associated PSALs in seven of the ten samples acquired at SWMU G. The highest metal concentrations were detected for soil samples SWMUG-4 and SWMUG-7 collected from the southwest corner of the area. Soil samples SWMUG-4 (2.6 ppm antimony [estimated], 101 ppm arsenic, 2.3 ppm cadmium, 33.6 ppm chromium, 95.3 ppm copper, and 238 ppm lead), SWMUG-7 (51.9 ppm copper, 104 ppm lead, and 335 ppm zinc), SWMUG-10 (26.7 ppm chromium, 10.1 ppm cobalt, and 25.6 ppm nickel), SWMUG-2 (5.4 ppm mercury [estimated]), SWMUG-5 (65.6 ppm arsenic and 121 ppm lead), SWMUG-8 (29.5 ppm arsenic), and SWMUG-9 (17.9 ppm arsenic and 2 ppm beryllium) contained metal concentrations which exceeded their respective PSALs.

Cyanide was detected in one of the ten surface soil samples acquired from SWMU G. Total cyanide results were then compared to the more conservative PSAL for amenable cyanide, since a value for total cyanide was not available. Soil sample SWMUG-1 exhibited a total cyanide concentration of 0.66 ppm which exceeded the PSAL for amenable cyanide.

The 80% UCL values for the SWMU G samples were compared to the constituent-specific PSAL values to evaluate the presence of significant constituent concentrations. Table 7-6 displays a comparison of the 80% UCL and the PSAL values for SWMU G.

As a result, the following COCs at SWMU G were retained for evaluation in the preliminary risk assessment:

- VOCs: none;
- SVOCs (8): acenaphthene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, chrysene, indeno(1,2,3-c,d)pyrene, pentachlorophenol, and phenanthrene;
- Pesticides/PCBs (1): Aroclor 1260;
- Metals (3): arsenic, lead, and mercury; and,
- Other Inorganics (1): cyanide.

7.3.5 Analytical Results for SWMU H

Analytical results for SWMU H were utilized to characterize the nature of any constituent concentrations in subsurface materials resulting from discharges to the former containment pond and ditch at this unit. There is an overlap in the areal extent of AOC 5 and SWMU H.

Forty four borings were advanced within SWMU H; thirty four borings were completed for trench verification/material identification purposes and ten borings were completed for collection of samples for chemical analysis. Ten soil samples were collected from ten of the borings for chemical analysis to identify any potential releases from this area. Boring locations are provided in Figures 7-20 and 7-21. Analytical results for soil samples collected from this unit are summarized in Table 7-7.

Eleven (11) VOC constituents including 1,2-dichloropropane (1,2-DCP), 1,2,3-trichloropropane (1,2,3-TCP), toluene, acetone, xylenes (m and p), o-xylene, benzene, chlorobenzene, 1,2-dichlorobenzene, ethylbenzene, and methyl ethyl ketone were detected in samples acquired from this area. A minimum of one VOC constituent was detected in each of the samples acquired from this area. The highest VOC concentrations were detected at soil boring locations SP09A and SP08B along the hydraulically "upstream" portions of the former trench to the west of Wyandotte Road, and SP03A collected along the eastern portion of the unit approximately 100 ft east of the pumphouse. Soil samples from SP09A, SP03A, and SP08B exhibited the highest 1,2-DCP concentrations of 50,000 ppm, 140 ppm, and 130 ppm, respectively. Soil samples SP08B and SP03A contained 17 ppm and 3.9 ppm [estimated] 1,2,3-TCP, respectively. Soil sample SP10A also contained 5.8 ppm toluene and 1.5 ppm m- and p-xylene.

Soil samples from four of the ten borings sampled within SWMU H contained concentrations which exceeded the PSAL for 1,2-DCP, namely SP's -09A, -03A, -08B, and -10A. In addition, soil samples from SP03A (1,2,3-TCP), SP08B (1,2,3-TCP), and SP10A (toluene, m- and p-xylene, chlorobenzene, and 1,2-dichlorobenzene) contained constituent concentrations which exceeded VOC PSALs in this area. The highest VOC concentrations were generally encountered between 9 ft - 18 ft bls.

Thirty (30) SVOC constituents were detected in the ten borings sampled in SWMU H. The highest SVOC concentrations were detected for soil samples collected along the western portions of SWMU H including SP09A (1,400 ppm bis(2-chloroisopropyl) ether [BCIE]), SP10A (130 ppm BCIE, 12 ppm bis(2-chloroethyl) ether [estimated], plus several PAHs), and SP08B (30 ppm BCIE). Soil sample SP03A just east of the pumphouse also exhibited elevated SVOC levels (4.5 ppm 4-nitrophenol, 2.8 ppm phenol, 1.9 ppm N-nitrosodi-n-propylamine, and 1.8 ppm BCIE). Soil samples for the remaining six transects all exhibited significantly lower SVOC concentrations.

Soil samples from three of the borings sampled within SWMU H contained concentrations which exceeded the PSAL for BCIE. Fifteen SVOC constituents from soil sample SP10A and six SVOC constituents from soil sample SP03A exceeded their respective PSALs. Twenty (20) SVOC constituents exceeded PSALs (acenaphthene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, bis(2-chloroethyl)ether, BCIE, bis(2-ethylhexyl) phthalate, 4-chloro-3-methylphenol, 2-chlorophenol, chrysene, 2,4-dimethylphenol, 2,4-dinitrotoluene, fluoranthene, 2-methylnaphthalene, 4-methylphenol, naphthalene, N-nitrosodi-n-propylamine, pentachlorophenol, phenanthrene, and 1,2,4-trichlorobenzene).

Three pesticide/PCB constituents were detected in one of the soil borings sampled in SWMU H. Soil sample SP10A exhibited constituent concentrations of 1.6 ppm for Aroclor 1248, 1.2 ppm [estimated] for Aroclor 1254, and 0.040 ppm [estimated] for alpha-chlordane. This soil boring was completed along the westernmost portion of SWMU H. These constituent concentrations exceeded their associated PSALs.

Three herbicide constituents were detected in two (SP03A and SP09B) of the ten borings sampled in SWMU H. The highest herbicide concentrations were detected for soil sample SP09A (420 ppb 2,4-D, 350 ppb 2,4,5-T, and 200 ppb 2,4,5-TP [Silvex]). Soil sample SP03A exhibited similar herbicide levels for the same three constituents. No spatial patterns were evident since the locations of the two referenced soil borings are located at both sides along the west-east span of the former trench. None of these constituent concentrations exceeded their associated PSALs.

Seventeen (17) metal constituents were detected for soil samples acquired from SWMU H. Metals constituents were detected at levels exceeding the associated PSALs in nine of the borings sampled in SWMU H. The highest metal concentrations were detected for soil samples SP09A and SP10A collected along the west side of the SWMU and soil sample SP01A collected from the easternmost transect of the unit. Soil sample SP09A (45.9 ppm antimony, 329 ppm arsenic, 344 ppm barium, 7.6 ppm beryllium, 8 ppm cadmium, 50.4 ppm chromium, 75.3 ppm cobalt, 77.3 ppm copper, 119 ppm lead, 1.6 ppm mercury, 103 ppm nickel, 295 ppm selenium, 8.6 ppm silver, 282 ppm thallium, 87.5 ppm vanadium, and 298 ppm zinc) contained metal concentrations which exceeded their respective PSALs. Soil samples SP10A and SP01A exhibited similar metals concentrations. With the exception of tin, metal concentrations exceeded their respective PSALs in at least one of these three samples (SP09A, SP10A, and SP01A).

Cyanide was detected in five of the samples acquired from SWMU H. The highest total cyanide concentrations were detected for soil samples SP10A (16 ppm [estimated]) and SP09A (6.6 ppm [estimated]) collected along the western portion of the area. Total cyanide results were then compared to the more conservative PSAL for <u>amenable</u> cyanide, since a value for total cyanide was not available. Four of the samples from SWMU H contained constituent concentrations which exceeded the PSAL for amenable cyanide.

The 80% upper confidence limit (UCL) values for the SWMU H samples were compared to the constituent-specific PSAL values to evaluate the presence of significant constituent concentrations. Table 7-8 displays a comparison of the 80% UCL and the PSAL values.

As a result, the following constituents of concern (COCs) at SWMU H were retained for evaluation in the preliminary risk assessment:

- VOCs (11): acetone, benzene, chlorobenzene, 1,2-dichlorobenzene, 1,2-DCP, ethylbenzene, methyl ethyl ketone, m- and p-xylenes, o-xylene, toluene, and 1,2,3-TCP;
- SVOCs (24): acenaphthene, benzo(a)anthracene, benzo(a)pyrene, benzo(g,h,i)perylene, benzo(b)fluoranthene, benzo(k)fluoranthene, bis(2-chloroethyl)ether, BCIE, bis(2-ethylhexyl) phthalate, 4-chloro-3-methylphenol, 2-chlorophenol, chrysene, 2,4-dimethylphenol, 2,4-dinitrotoluene, fluoranthene, indeno (1,2,3-cd)pyrene,

2-methylnaphthalene, 4-methylphenol, naphthalene, 4-nitrophenol, N-nitrosodi-n-propylamine, pentachlorophenol, phenanthrene, and 1,2,4-trichlorobenzene;

- Pesticides/PCBs (3): alpha-chlordane, Aroclor 1248, and Aroclor 1254;
- Metals (14): antimony, arsenic, beryllium, cadmium, chromium, cobalt, copper, lead, mercury, nickel, selenium, silver, thallium, and vanadium; and,
- Other Inorganics (1): cyanide.

Tentatively Identified Compounds (TICs)

In conformance with the QAPP, volatile and semivolatile Tentatively Identified Compounds (TICs) were evaluated for each sample collected from SWMU H. Quanterra analyzed for PDC isomers (i.e., 1,3-PDC and 2,2-PDC) as TICs using 1,2-PDC standards to quantitate any detected peaks.

Volatile TICs primarily included unknowns, unknown hydrocarbons, unknown alkanes, and alkanes. Volatile TICs were observed in two of the ten samples from SWMU H (SP01A and SP10A). The highest volatile TIC concentrations were detected for soil boring location SP10A along the hydraulically "upstream" portion of the former trench to the west of Wyandotte Road. Observed TICs included 16.2 ppm of a cyclohexane isomer, 4,200 ppm of an unknown, 8,100 ppm of an unknown alkane, and 52,900 ppm of an unknown hydrocarbon.

Semivolatile TICs included sulfur (S8), unknowns, unknown hydrocarbons, cyclohexanone, and diphenyl sulfone. The detection of an aldol condensation product was rendered to be a laboratory artifact. Semivolatile TICs were observed in most of the samples from SWMU H. The highest semivolatile TIC concentrations were detected for soil boring location SP10A along the hydraulically "upstream" portion of the former trench. Observed TICs at this location included 52.9 ppm of an unknown hydrocarbon (estimated), 8,100 ppm of an unknown alkane, and 4,200 ppm of an unknown.

7.3.6 Analytical Results for AOC 2

Analytical results for AOC 2 were utilized to assess the horizontal extent of potential coke-related wastes in this AOC, especially along the eastern edge of the area.

Fifty one total borings were advanced along the anticipated perimeter of AOC 2. Twenty five of these boring locations constituted "step-out" locations at which visual/olfactory evidence of coke-related wastes were noted. At these locations, the impacted boring was plugged and a new boring was advanced at a location of 20-40 ft further away from the source area. In this manner, the horizontal extent of AOC 2 was defined with an approximate 100-ft spacing between sampling locations.

Following delineation of the horizontal extent, confirmatory soil samples were collected from eight equally spaced perimeter borings. One soil sample from each of the eight borings was submitted for chemical analysis to confirm the horizontal delineation process. Boring locations are provided in Figure 7-22. Analytical results for constituents detected in soil samples from this unit are summarized in Table 7-9.

VOCs were detected in two of the eight perimeter samples acquired from AOC 2. Seven VOC constituents were detected at low levels in sample SG005AOC2-7 including acetone (100 ppb [estimated]), benzene (27 ppb), ethylbenzene (4.9 ppb [estimated]), methylene chloride (27 ppb), toluene (43 ppb), xylene (m and p [25 ppb]), and o-xylene (6.1 ppb [estimated]). Toluene was the only VOC detected in sample SG001AOC2-6 at a concentration of 13 ppb. None of the other six samples exhibited any detectable VOC concentrations.

None of the soil samples from AOC 2 contained constituent concentrations which exceeded VOC PSALs.

Eighteen (18) SVOC constituents were detected in the eight perimeter borings from AOC 2; seventeen of the eighteen SVOCs were PAHs. Soil sample SG003AOC2-1 exhibited the highest SVOC concentrations including 2.7 ppm fluoranthene, 2.6 ppm pyrene, and 2.2 ppm benzo(b)fluoranthene. The highest SVOC concentration for a single parameter was detected in soil sample SG008AOC2-3 (3.4 ppm 2-methylnaphthalene). Other soil samples from AOC 2 exhibited similarly low or non-detected SVOC levels, primarily consisting of PAHs.

Soil samples from three of the eight samples collected from AOC 2 contained concentrations which exceeded at least one SVOC PSAL. Eight SVOC constituents from soil sample SG003AOC2-1, three SVOCs from soil sample SG008AOC2-3, and two SVOCs from soil sample SG005AOC2-7 exceeded their respective PSALs. Nine SVOC constituents exceeded PSALs (benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, indeno(1,2,3-c,d)pyrene, 2-methylnaphthalene, naphthalene, and phenanthrene).

Eleven metal constituents were detected for samples acquired from AOC 2. Metals constituents were detected at levels exceeding the associated PSALs in seven of the eight samples acquired at AOC 2. Soil samples SG003AOC2-1 (34 ppm arsenic, 1.2 ppm mercury [estimated]), SG003AOC2-3 (19.8 ppm arsenic), SG003AOC2-4 (12.1 arsenic, 3.5 ppm cadmium, and 966 ppm zinc), SG003AOC2-5 (101 ppm chromium, 17. 1 ppm mercury), SG003AOC2-6 (41 ppm arsenic, 78.1 ppm lead), SG003AOC2-7 (19.8 ppm arsenic), and SG003AOC2-8 (12.4 ppm arsenic, 52.5 ppm chromium) contained metal concentrations which exceeded their respective PSALs.

Cyanide was detected in six of the eight soil samples acquired from AOC 2. Detected total cyanide concentrations ranged from 1 ppm - 46 ppm. Total cyanide results were then compared to the more conservative PSAL for amenable cyanide, since a value for total cyanide was not available. Six of the eight soil samples from this area exhibited a total cyanide concentration which exceeded the PSAL for amenable cyanide.

The 80% UCL values for the AOC 2 samples were compared to the constituent-specific PSAL values to evaluate the presence of significant constituent concentrations. Table 7-10 displays a comparison of the 80% UCL and the PSAL values for AOC 2.

As a result, the following COCs at AOC 2 were retained for evaluation in the preliminary risk assessment:

- VOCs: none;
- SVOCs (3): 2-methylnaphthalene, naphthalene, and phenanthrene;
- Metals (4): arsenic, chromium, mercury, and zinc; and,
- Other inorganics (1): cyanide.

7.3.7 Analytical Results for AOC 4

Analytical results for AOC 4 were utilized to characterize the nature of any constituent concentrations in deposited coal tar materials.

Two tar characterization samples were collected from the interior of AOC 4. Both tar samples were submitted for chemical analysis to characterize the nature of the waste material. Boring locations are provided in Figure 7-23. Analytical results for constituents detected in tar samples from this unit are summarized in Table 7-11.

VOCs were detected in both of the tar characterization samples acquired from AOC 4. Five VOC constituents were detected at elevated levels in sample SG003AOC4-1 including benzene (680 ppm), styrene (240 ppm [estimated]), toluene (590 ppm), m/p-xylenes (740 ppm), and o-xylene (240 ppm [estimated]). Similarly elevated levels were detected in sample SG001AOC4-2 including benzene (250 ppm), styrene (96 ppm [estimated]), toluene (190 ppm), and m/p-xylenes (170 ppm).

Nineteen (19) SVOC constituents were detected at elevated concentrations in the tar samples from AOC 4. Tar sample SG003AOC4-1 exhibited the highest SVOC concentrations including 48,000 ppm naphthalene, 23,000 ppm phenanthrene, 14,000 ppm fluoranthene, and 9,300 ppm acenaphthylene. Similarly elevated SVOC levels were also detected for sample SG001AOC4-2.

Ten metal constituents were detected for the tar samples acquired from AOC 4. Four metal constituents were detected at levels which exceeded the associated PSALs. Tar samples SG003AOC4-1 (20.5 ppm arsenic, 82.8 ppm lead, 3.6 ppm selenium, 14 ppm thallium) and SG001AOC4-2 (14.5 ppm arsenic, 7.2 ppm thallium) contained metal concentrations which exceeded their respective PSALs.

Cyanide was detected in both of the tar samples acquired from AOC 4 at concentrations of 11 ppm and 19 ppm. Total cyanide results were then compared to the more conservative PSAL for amenable cyanide, since a value for total cyanide was not available. Both of the tar samples from this area exhibited a total cyanide concentration which exceeded the PSAL for amenable cyanide.

As a result, the following constituents of concern (COCs) at AOC 4 were retained for evaluation in the preliminary risk assessment:

- VOCs (5): benzene, styrene, toluene, m- and p-xylene, and o-xylene;
- SVOCs (19): acenaphthylene, anthracene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, chrysene, dibenzofuran, fluoranthene, fluorene, indeno(1,2,3-cd)pyrene, 2-methylnaphthalene, 3-methylphenol, 4-methylphenol, naphthalene, phenanthrene, phenol, and pyrene;
- Metals (4): arsenic, lead, selenium, and thallium; and,
- Other Inorganics (1): cyanide.

Two tar samples from AOC 4 were also submitted to off-site laboratories for evaluation of BTU content, moisture content, compaction, and strength. BTU analyses yielded similar values of 13,148.3 Btu/lb and 10,667.1 Btu/lb for tar samples SG-003-AOC4-1 and SG-003-AOC4-2, respectively. Due to the viscous nature of the tar samples, lack of soil content, and presence of volatile organic constituents, the other three physical analyses could not be performed.

7.3.8 Analytical Results for AOC 5

Analytical results for AOC 5 were utilized to characterize the horizontal and vertical extent of PDC-related VOCs and SVOCs in soils. As previously stated in Section 7.3.5, there is an overlap in the areal extent of AOC 5 and SWMU H.

Sixteen (16) soil samples were collected from borings completed for monitoring wells RFIMW-7 and RFIMW-8. Six soil samples from soil boring RFIMW07 and ten soil samples from soil boring RFIMW08 were submitted for chemical analysis of VOCs/SVOCs to supplement prior characterization activities conducted by BASF for this area in 1985. Boring locations are provided in Figure 7-24. Analytical results for constituents detected in soil samples from AOC 5 are summarized in Table 7-12.

Nine (9) VOC constituents were detected at low levels in samples acquired from AOC 5. These VOCs included acetone, carbon disulfide, 1,1-dichloroethane, ethylbenzene, methyl ethyl ketone, m- and p-xylene, o-xylene, toluene, and 1,1,1-trichloroethane. Detected VOC concentrations ranged from 2.6 ppb - 160 ppb (estimated), and were primarily encountered within the deeper samples collected from RFIMW07 (10-16 ft bls) and in the shallower samples from RFIMW08.

None of the soil samples from AOC 5 contained VOC concentrations which exceeded their respective PSALs.

Twenty two (22) SVOCs constituents were detected at least once in the 16 soil boring samples from AOC 5; fifteen of the twenty two SVOCs were PAHs. Soil sample SG004RFIMW08 exhibited the highest concentrations for 12 constituents including benzo(a)anthracene (830 ppb), benzo(b)fluoranthene (870 ppb), benzo(k)fluoranthene (290 ppb [estimated]), benzo(g,h,i)perylene (230 ppb [estimated]), benzo(a)pyrene (580 ppb), chrysene (680 ppb), di-n-octyl phthalate (260 ppb [estimated]), fluoranthene (1,700 ppb), fluorene (150 ppb [estimated]), indeno(1,2,3-cd)pyrene (280 ppb [estimated]), phenanthrene (1,300 ppb), and pyrene (1,400 ppb). SVOCs were not detected in five of the six deepest samples collected from soil boring RFIMW08.

The highest SVOC concentrations were detected for the deeper samples acquired from soil boring RFIMW07 at depths ranging from 10-19 ft bls. However, only four SVOCs were actually detected. Analytical results for the soil samples acquired from soil boring RFIMW08 confirmed the absence of SVOCs (except 2 low detectable levels of bis(2-ethylhexyl) phthalate) at depths greater than 13 ft bls for this boring location.

Five of the sixteen samples collected from AOC 5 contained concentrations which exceeded only one SVOC PSAL; one other sample exhibited concentrations which exceeded two SVOC PSALs. Three SVOC constituents were detected at levels which exceeded the associated PSALs. Soil samples SG010RFIMW07 (5,500 ppb 2-methylnaphthalene (estimated), 1,100 ppb phenanthrene [estimated]), SG013RFIMW07 (690 ppb 2-methylnaphthalene [estimated]), SG016RFIMW07 (2,100 ppb 4-methylphenol), SG019RFIMW07 (1,600 ppb 4-methylphenol), SG004RFIMW08 (1,300 ppb phenanthrene), and SG010RFIMW08 (780 ppb phenanthrene) contained SVOC concentrations which exceeded their respective PSALs.

The 80% UCL values for the AOC 5 samples were compared to the constituent-specific PSAL values to evaluate the presence of significant constituent concentrations. Table 7-13 displays a comparison of the 80% UCL and the PSAL values for AOC 5.

As a result, the following COCs at AOC 5 were retained for evaluation in the preliminary risk assessment:

- SVOCs (2): 2-methylnaphthalene and 4-methylphenol.

7.3.9 Analytical Results for AOC 6

Analytical results for AOC 6 were utilized to assess the horizontal and vertical extent of coal tar-related wastes in this AOC.

One hundred twenty four (124) total borings were advanced to assess the perimeter of AOC 6. Sixty one (61) of these boring locations constituted "step-out/in" locations at which PID/visual evidence (or absence) of coal tar-related wastes was noted. At these locations, the impacted boring was plugged and a new boring was advanced at a location of 10-50 ft further away from (or closer toward) the source area. In this manner, the horizontal extent of AOC 6 was defined with an approximate 100-ft spacing between sampling locations.

Following preliminary delineation of the horizontal extent, confirmatory soil samples were collected from eight equally spaced perimeter borings. One soil sample from each of the eight borings was submitted for chemical analysis to confirm the horizontal extent of AOC 6. Based on preliminary laboratory results which indicated slightly elevated SVOC levels for four of the eight samples, four additional step-out samples were collected to supplement the horizontal delineation process. Boring locations are provided in Figure 7-25. Analytical results for constituents detected in soil samples from this unit are summarized in Table 7-14.

VOCs were detected at very low concentrations in five of the eight perimeter samples acquired from AOC 6. Three VOC constituents were detected in the sample from soil boring SP62A including 1,2-dichloropropane (22 ppb [estimated]), chloroform (10 ppb [estimated]), and 1,2,3-trichloropropane (9 ppb [estimated]). Similar levels were detected in the sample from soil boring SP64 including methylene chloride (9 ppb), 1,2-dichloropropane (4.7 ppb [estimated]), and benzene (2.6 ppb [estimated]). Non-detectable results for five VOCs were deemed unusable during the data validation process, e.g. these constituents may or may not be present in the collected samples.

Soil sample SP62A (9 ppb 1,2,3-trichloropropane [estimated]) was the only sample from AOC 6 which exceeded a VOC PSAL.

Twenty two (22) SVOC constituents were detected in the eight perimeter borings from AOC 6; seventeen of the twenty two SVOCs were PAHs. The highest SVOC concentrations were detected for three soil boring locations (SP62A, SP61A, and SP58) collected within the northeastern portion of AOC 6. Soil sample SP62A exhibited the highest SVOC concentrations including 50 ppm fluoranthene, 45 ppm phenanthrene, 35 ppm pyrene, and 28 ppm benzo(b)fluoranthene. Other soil samples from AOC 6 exhibited low or non-detected SVOC levels, primarily consisting of PAHs.

Seven of the eight samples collected from AOC 6 contained concentrations which exceeded at least one SVOC PSAL. Twelve SVOC constituents from soil sample SP62A, ten SVOCs from soil sample SP61A, and eight SVOCs from soil sample SP58 exceeded their respective PSALs. Fourteen (14) SVOC constituents exceeded PSALs (acenaphthene, acenaphthylene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(g,h,i)perylene, chrysene, dibenz(a,h)anthracene, fluoranthene, indeno(1,2,3-c,d)pyrene, 2-methylnaphthalene, naphthalene, and phenanthrene).

Twelve metal constituents were detected for samples acquired from AOC 6. Metals constituents were detected at levels exceeding the associated PSALs in five of the eight samples acquired at AOC 6. Soil samples SP62A (29.6 ppm arsenic, 138 ppm lead, 3.3 ppm mercury, 33.9 ppm nickel [estimated], 252 ppm zinc [estimated]), SP61A (53.2 ppm chromium, 48.7 ppm copper, 65 ppm lead, and 31.1 ppm nickel [estimated]), SP55A (44.9 ppm arsenic, 49.4 ppm copper, 308 ppm lead), SP65 (38.3 ppm arsenic), and SP63 (25.7 ppm arsenic) contained metal concentrations which exceeded their respective PSALs.

Cyanide was detected in five of the eight soil samples acquired from AOC 6. Detected total cyanide concentrations ranged from 0.49 ppm - 2.4 ppm (estimated). Total cyanide results were then compared to the more conservative PSAL for <u>amenable</u> cyanide, since a value for total cyanide was not available. Five of the eight soil samples from this area exhibited a total cyanide concentration which exceeded the PSAL for amenable cyanide.

The 80% UCL values for the AOC 6 samples were compared to the constituent-specific PSAL values to evaluate the presence of significant constituent concentrations. Table 7-15 displays a comparison of the 80% UCL and the PSAL values for AOC 6.

As a result, the following COCs at AOC 6 were retained for evaluation in the preliminary risk assessment:

- VOCs (1): 1,2,3-trichloropropane;
- SVOCs (14): (acenaphthene, acenaphthylene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(g,h,i)perylene, chrysene, dibenz(a,h)anthracene, fluoranthene, indeno(1,2,3-c,d)pyrene, 2-methylnaphthalene, naphthalene, and phenanthrene);
- Metals (7): arsenic, chromium, copper, lead, mercury, nickel, and zinc; and,
- Other inorganics (1): cyanide.

7.3.10 Analytical Results for AOC 7

Analytical results for AOC 7 were utilized to 1) characterize the nature of any constituent concentrations in deposited Prussian Blue (ferric ferrocyanide) materials, 2) estimate the vertical extent of Prussian Blue materials, and 3) define the horizontal extent of potential Prussian Blue materials for each of the three AOC 7 areas.

Two borings were advanced within AOC 7A at areas previously sampled by EPA which contained visible surficial evidence of Prussian Blue. Soil samples were collected from these two locations to evaluate the vertical extent of Prussian Blue. Samples were analyzed for metals and total cyanide only. Analytical results for constituents detected in soil samples from the vertical delineation borings are summarized in Table 7-16.

Twelve (12) metal constituents were detected for the vertical delineation samples acquired <u>within</u> AOC 7A. Metals constituents were detected at levels exceeding the associated PSALs in five of the six samples analyzed for metals. Soil samples SG011AOC7-SP02I-S (27 ppm chromium, 9.7 ppm cobalt, 31.8 ppm nickel [estimated], and 41.3 ppm vanadium), SG004AOC7-SP02D (44 ppm arsenic, 24.7 ppm chromium), SG006AOC7-SP02E-S (34.2 ppm arsenic, 29.1 ppm chromium), SG002AOC7-SP01C (21.6 ppm arsenic, 226 ppm lead, 4.8 ppm mercury, and 22.7 ppm nickel [estimated]), and SG003AOC7-SP01D (335 ppm lead and 3.3 ppm mercury) contained metal concentrations which exceeded their respective PSALs.

Cyanide was detected in ten of the eleven soil samples acquired for cyanide analysis <u>within</u> AOC 7A. Detected total cyanide concentrations ranged from 0.32 ppm - 5.7 ppm. No trends could be established regarding the vertical distribution of cyanide. Total cyanide results were then compared to the more conservative PSAL for <u>amenable</u> cyanide, since a value for total cyanide was not available. Ten of the eleven soil samples from the vertical delineation borings exhibited a total cyanide concentration which exceeded the PSAL for amenable cyanide.

Trenching methods were then utilized to define the horizontal extent of each AOC 7 area. In areas where trenching could not be completed due to buried utility lines or other physically limiting factors, soil borings were advanced to define the perimeter. In this manner, the horizontal extent of each AOC 7 area was defined.

Following delineation of the horizontal extent, confirmatory soil samples were collected from equally spaced perimeter borings. One soil sample from each of the borings was submitted for chemical analysis to confirm the horizontal delineation process. Boring locations are provided in Figures 7-26, 7-27, and 7-28. Analytical results for constituents detected in soil samples from each sub-area are summarized in Table 7-17.

AOC 7A

Following delineation of the horizontal extent for AOC 7A, confirmatory soil samples were collected from eight equally spaced perimeter borings. Laboratory analyses were completed to evaluate the potential presence of metals and cyanide.

Thirteen (13) metal constituents were detected for samples acquired from the perimeter of AOC 7A. Metal constituents were detected at levels exceeding the associated PSALs in six of the eight samples acquired at AOC 7A. Soil samples SG003AOC7-SP05 (15.6 ppm arsenic, 1.7 ppm mercury [estimated]), SG003AOC7-SP09A (84.9 ppm lead [estimated], 2.8 ppm mercury), SG004AOC7-SP10A (49 ppm arsenic [estimated], 1.1 ppm mercury [estimated], and 19.4 ppm silver), SG003AOC7-SP06 (17.8 ppm arsenic), SG003AOC7-SP04 (1.5 ppm mercury [estimated]), and SG003AOC7-SP08B (81.5 ppm lead [estimated]) contained metal concentrations which exceeded their respective PSALs.

Cyanide was detected in four of the eight soil samples acquired from the perimeter of AOC 7A. Total cyanide results were then compared to the more conservative PSAL for amenable cyanide, since a value for total cyanide was not available. Detected total cyanide concentrations ranged from 0.48 ppm (estimated) - 2.7 ppm (estimated). All four of the soil samples from this area which exhibited detectable total cyanide concentrations exceeded the PSAL for amenable cyanide.

AOC 7B

Following delineation of the horizontal extent for AOC 7B, confirmatory soil samples were collected from four equally spaced perimeter borings. Laboratory analyses were completed to evaluate the potential presence of metals and cyanide.

Eleven (11) metal constituents were detected for samples acquired from the perimeter of AOC 7B. Only soil sample SG005AOC7-SP34 (26.9 ppm chromium [estimated]) contained a metal concentration which exceeded the respective PSAL.

Cyanide was not detected in any of the four soil samples acquired from the perimeter of AOC 7B.

AOC 7C

Following delineation of the horizontal extent for AOC 7C, confirmatory soil samples were collected from four equally spaced perimeter borings. Laboratory analyses were completed to evaluate the potential presence of metals and cyanide.

Twelve (12) metal constituents were detected for samples acquired from the perimeter of AOC 7C. All four soil samples contained an arsenic concentration which exceeded the respective PSAL. In addition, soil sample SG004AOC7-SP39 (113 ppm lead [estimated], 2.2 ppm mercury, 89.9 ppm nickel, and 603 ppm zinc) contained metal concentrations which exceeded the respective PSALs.

Cyanide was not detected in any of the four soil samples acquired from the perimeter of AOC 7C.

The 80% UCL values for the AOC 7 samples were compared to the constituent-specific PSAL values to evaluate the presence of significant constituent concentrations. Tables 7-18, 7-19, 7-20, and 7-21 display a comparison of the 80% UCL and the PSAL values for each of the AOC 7 areas.

As a result, the following COCs at AOC 7 (inclusive of AOC 7A, AOC 7B, and AOC 7C) were retained for evaluation in the preliminary risk assessment:

- Metals (7): arsenic, chromium, lead, mercury, nickel, silver, and zinc; and,
- Other inorganics (1): cyanide.

7.4 Analytical Results for Groundwater Monitoring Events

Groundwater monitoring results for the background, perimeter, and non-network monitoring wells are summarized below. The analytical laboratory data were assessed and validated based upon a review of standard quality control criteria established by the QAPP. Copies of the data validation reports and the associated analytical results are provided under separate cover as Appendix D.

7.4.1 Analytical Results for Background Groundwater Monitoring Events

Three monthly and three subsequent quarterly groundwater monitoring events were conducted to characterize background conditions in groundwater beneath the Facility. For each monitoring event, groundwater samples were collected from seven pre-determined monitoring wells along the western corridor of the Facility and submitted for laboratory analysis. Analytical results for groundwater samples collected from the background monitoring wells are summarized in Tables 7-22 through 7-27. Due to the presence of SVOCs in samples acquired from RFIMW-28, results for this monitoring well were excluded from background determinations.

Laboratory analytical results were statistically evaluated for 22 constituents detected in at least one background groundwater sample. These results were evaluated to determine concentrations which are representative of site-specific background conditions. Calculations were performed to yield mean concentration values for the detected constituents. A summary of these statistically derived mean background groundwater concentrations is provided in Table 7-28.

As previously stated in Section 4.0, the background groundwater values were compared with the MDEQ GSI-based action levels to yield appropriate PSAL values. The selected PSALs were then compared with analytical data from investigative samples collected during the Phase I RFI to evaluate groundwater impacts at a particular sampling location.

7.4.2 Analytical Results for Quarterly Groundwater Monitoring of Perimeter Wells

Phase I RFI field investigation tasks were also conducted to characterize the nature and extent of constituent concentrations in groundwater beneath the Facility.

Groundwater samples were collected from 15 perimeter and 10 "non-network" monitoring wells (non-network wells were only sampled during the first quarterly monitoring event) for chemical analysis to identify any potential releases from the Facility. Analytical results for groundwater samples collected from the 15 perimeter monitoring wells are summarized in Tables 7-29 through 7-43. Selected groundwater analytical results for each of the four quarterly monitoring events are provided in Figures 7-29 through 7-32.

The 80% UCL values were calculated for each monitoring well location using acquired data from the four quarterly sampling events. The 80% UCL values for the groundwater samples were compared to the constituent-specific PSAL values to evaluate the presence of significant constituent concentrations. Tables 7-29 through 7-43 display a comparison of the 80% UCL and the PSAL values for each perimeter monitoring well.

7.4.2.1 VOCs in Perimeter Groundwater Monitoring Wells

A limited number of VOCs were detected in groundwater samples collected from the network of perimeter wells. Although at least one VOC was encountered in 13 of the 15 perimeter wells, the detected VOC concentrations were generally low, e.g. 50 ppb or less. Monitoring well RFIMW-22 represents a notable exception along the northern Facility boundary where five VOC constituents were consistently detected at higher levels. VOCs detected from RFIMW-22 and their associated annualized mean concentrations included acetone (11,125 ppb), benzene (2,750 ppb), chlorobenzene (59 ppb), toluene (96 ppb), and vinyl chloride (217 ppb).

The 80% UCL values for each of the perimeter monitoring wells were compared to the constituent-specific PSAL values to evaluate the presence of significant VOC concentrations in groundwater. Only the benzene, chlorobenzene, and vinyl chloride 80% UCL values for perimeter monitoring well RFIMW-22 exceeded applicable VOC PSALs. In addition, monitoring well RFIMW-22 represented the only perimeter well with 80% UCL values which exceeded applicable VOC PSALs. Table 7-41 displays a comparison of the 80% UCL and the PSAL values for RFIMW-22.

As a result of examining constituent concentrations present at the perimeter monitoring wells, the following three groundwater-associated VOCs were retained as COCs for evaluation in the preliminary risk assessment: benzene, chlorobenzene, and vinyl chloride.

7.4.2.2 SVOCs in Perimeter Groundwater Monitoring Wells

Fifteen (15) SVOCs were detected in groundwater samples collected from the network of perimeter wells. At least one SVOC was encountered in each of the 15 perimeter wells. The highest SVOC level was encountered at monitoring well RFIMW-12 along the southeast corner of the Facility which exhibited a mean concentration value of 794 ppb phenol.

The highest SVOC concentrations were consistently detected for three monitoring wells: RFIMW-12, RFIMW-7, and RFIMW-22. However, the locations of these three perimeter monitoring wells are widely dispersed in the southeast, east central, and northeast portions of the Facility.

In addition to an elevated phenol value as referenced above, groundwater samples from RFIMW-12 exhibited elevated mean levels of 3-methylphenol/4-methylphenol (126 ppb). Groundwater samples from RFIMW-7 exhibited elevated mean levels of phenol (124 ppb), 2-methylnaphthalene (86 ppb), and naphthalene (55 ppb). Groundwater samples from RFIMW-22 exhibited elevated mean levels of 1,4-dioxane (555 ppb), o-toluidine (184 ppb), pyridine (173 ppb), phenol (146 ppb), and bis(2-chloroethyl) ether (88 ppb).

Perimeter monitoring well RFIMW-23 represented a noteworthy exception since it was the only monitoring well to exhibit a wide diversity of PAH constituents, although the mean concentrations were generally less than 10 ppb. This monitoring well is located along the northwest corner of the Facility boundary. PAHs were not detected at either of the adjacent monitoring wells (RFIMW-24 and RFIMW-22).

The 80% UCL values for each of the perimeter monitoring wells were compared to the constituent-specific PSAL values to evaluate the presence of significant SVOC concentrations in groundwater. Six SVOC constituents from monitoring well RFIMW-23 (PAHs only), three SVOCs from monitoring well RFIMW-22, three SVOCs from monitoring well RFIMW-7, two SVOCs from monitoring well RFIMW-2 (bis[2-chloroethyl] ether, 4-methylphenol), two SVOCs from monitoring well RFIMW-3 (bis[2-chloroethyl] ether, 4-methylphenol), one SVOC from monitoring well RFIMW-5 (4-methylphenol), and one SVOC from monitoring well RFIMW-12 (4-methylphenol) exceeded their respective PSALs.

The following thirteen (13) groundwater-associated SVOCs exceeded PSALs and were retained as COCs for evaluation in the preliminary risk assessment: acenaphthene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, bis(2-chloroethyl) ether, bis(2-chloroisopropyl) ether, chrysene, 2-methylnaphthalene, 4-methylphenol, naphthalene, pyridine, and o-toluidine.

7.4.2.3 Inorganics in Perimeter Groundwater Monitoring Wells

Metals

Ten (10) metals were detected in groundwater samples collected from the network of perimeter wells. The highest total metals concentrations were consistently detected for five monitoring wells: RFIMW-11, RFIMW-12, PM1NA, RFIMW-22, and RFIMW-7. The locations of these five perimeter monitoring wells are widely dispersed in the southeast, east central, and northeast portions of the Facility. Monitoring wells RFIMW-11, RFIMW-12 and PM1NA are all located in the southeast corner of the Facility; RFIMW-7 is located in the east central portion of the Facility; and, RFIMW-22 is located along the northern boundary of the Facility.

Elevated mean total metals values were exhibited by the following perimeter monitoring well locations:

- RFIMW-11 (southeast): arsenic (0.097 ppm), cadmium (0.0029 ppm), copper (0.283 ppm), lead (0.162 ppm), mercury (0.0042 ppm), vanadium (0.059 ppm), and zinc (0.356 ppm);
- RFIMW-12 (southeast): arsenic (0.365 ppm), mercury (0.0044 ppm), nickel (0.243 ppm), selenium (0.007 ppm), and vanadium (0.348 ppm);
- PM1NA (southeast): arsenic (0.443 ppm), lead (0.05 ppm), vanadium (0.061 ppm), and zinc (0.167 ppm);
- RFIMW-7 (east central): selenium (0.019 ppm); and
- RFIMW-22: arsenic (0.31 ppm), selenium (0.009 ppm), and vanadium (1.005 ppm).

Comparison of total and filtered metals results indicates that metal constituents are present in both dissolved and suspended phases. Furthermore, filtered constituent concentrations exceeded PSALs in several instances, thereby substantiating the need for continued evaluation of metals in the dissolved phase.

Cyanide

Total cyanide was detected in groundwater samples collected from the network of perimeter wells. Cyanide was encountered in four of the 15 perimeter wells.

The highest total cyanide concentrations were detected at perimeter monitoring well locations at opposite ends of the Facility. Elevated total cyanide concentrations were detected for two monitoring wells located in the northern portion of the Facility: RFIMW-22 and RFIMW-23. However, elevated concentrations were also detected for two monitoring wells located at the opposite end of the Facility in the southeast corner: RFIMW-12 and PM1NA.

Comparison of Inorganics (Metals and Total Cyanide) with PSALs

The 80% UCL values for each of the perimeter monitoring wells were compared to the constituent-specific PSAL values to evaluate the presence of significant inorganic concentrations in groundwater. The following inorganic constituents exceeded applicable PSALs for the 14 designated perimeter monitoring well locations:

- ten (10) inorganics from monitoring well RFIMW-12 (arsenic, cadmium, copper, lead, mercury, nickel, selenium, vanadium, zinc, and total cyanide);
- six (6) inorganics from monitoring well RFIMW-11 (arsenic, cadmium, copper, lead, mercury, nickel, vanadium, and zinc, and total cyanide);
- six (6) inorganics from monitoring well RFIMW-22 (arsenic, copper, lead, selenium, vanadium, and total cyanide);
- six (6) inorganics from monitoring well RFIMW-2 (barium, cadmium, copper, lead, vanadium, and zinc);
- six (6) inorganics from monitoring well RFIMW-3 (barium, cadmium, copper, lead, vanadium, and zinc);
- five (5) inorganics from monitoring well PM1NA (arsenic, lead, vanadium, zinc, and total cyanide);
- four (4) inorganics from monitoring well RFIMW-8 (barium, cadmium, copper, zinc);
- two (2) inorganics from monitoring well RFIMW-5 (barium and selenium);
- two (2) inorganics from monitoring well RFIMW-6 (mercury and selenium);
- two (2) inorganics from monitoring well RFIMW-7 (copper and selenium);
- two (2) inorganics from monitoring well RFIMW-9 (cadmium and zinc);
- two (2) inorganics from monitoring well RFIMW-23 (zinc and total cyanide);
- one (1) inorganic from monitoring well RFIMW-4 (arsenic); and
- one (1) inorganic from monitoring well RFIMW-10 (barium).

The following eleven (11) groundwater-associated inorganics exceeded PSALs and were retained as COCs for evaluation in the preliminary risk assessment: arsenic, barium, cadmium, copper, lead, mercury, nickel, selenium, vanadium, zinc, and total cyanide.

7.4.3 Analytical Results for Groundwater Monitoring of Non-Network Wells

Phase I RFI field investigation tasks were also conducted to preliminarily characterize the nature and extent of constituent concentrations in groundwater for locations adjacent to specific SWMUs/AOCs at the Facility.

Groundwater samples were collected from 10 original "non-network" monitoring wells (non-network wells were only sampled during the first quarterly monitoring event) for chemical analysis to identify any potential releases from the Facility. Based on the detected SVOC levels for monitoring well RFIMW-28 (originally designated as a background monitoring well), results for this well location were also incorporated with this data set. Analytical results for groundwater samples collected from the 11 non-network monitoring wells are summarized in Table 7-44.

7.4.3.1 VOCs for Non-Network Monitoring Wells

Seven (7) VOCs were detected in groundwater samples collected from the non-network monitoring wells. The detected VOC concentrations were generally less than 50 ppb. Monitoring wells RFIMW-21 and RFIMW-16 in the east central portion of the Facility exhibited acetone concentrations of 2,100 ppb (estimated) and 540 ppb (estimated), respectively. The groundwater sample from monitoring well RFIMW-16 also contained 43 ppb (estimated) methyl ethyl ketone. Monitoring well RFIMW-13 exhibited a 1,2-dichloroethane concentration of 28 ppb (estimated).

None of the non-network groundwater monitoring well samples contained VOC constituent concentrations which exceeded applicable PSALs.

7.4.3.2 SVOCs in Non-Network Groundwater Monitoring Wells

Eight (8) SVOCs were detected in groundwater samples collected from the non-network monitoring wells. The detected SVOC concentrations were generally less than 50 ppb. Monitoring well RFIMW-28 in the southwest corner of the Facility exhibited a 4-methylphenol concentration of 16.71 ppb. Monitoring well PM3NB in the west central portion of the Facility exhibited a bis(2-chloroisopropyl) ether concentration of 39 ppb.

Both of the above-referenced concentrations for bis(2-chloroisopropyl) ether and 4-methylphenol exceeded their respective PSALs. As a result, these two SVOC constituents were retained as COCs for evaluation in the preliminary risk assessment.

7.4.3.3 Inorganics in Non-Network Groundwater Monitoring Wells

Metals

Eleven (11) metals were detected in groundwater samples collected from the non-network monitoring wells. Samples from the following monitoring well locations exhibited total metals concentrations which exceeded applicable PSALs:

- RFIMW-15 (east central): cadmium (0.0052 ppm), copper (0.13 ppm), lead (0.062 ppm), mercury (0.0012 ppm), vanadium (0.095 ppm), and zinc (0.54 ppm);
- RFIMW-28 (southwest): cadmium (0.002 ppm) and vanadium (0.028 ppm);
- RFIMW-16 (east central): selenium (0.0065 ppm) and vanadium (0.2 ppm); and
- RFIMW-13 (north): zinc (0.18 ppm).

The following seven (8) groundwater-associated inorganics exceeded PSALs and were retained as COCs for evaluation in the preliminary risk assessment: arsenic, cadmium, copper, lead, mercury, selenium, vanadium, and zinc.

Cyanide

Total cyanide was detected in four of the groundwater samples collected from the non-network monitoring wells. Monitoring well RFIMW-16 in the east central portion of the Facility exhibited the highest total cyanide concentration of 0.39 ppm (estimated).

None of the non-network groundwater monitoring well samples contained total cyanide concentrations which exceeded the applicable PSAL.

7.4.3.4 SWMU/AOC-Specific Groundwater Evaluations

In addition to the site-wide groundwater evaluations described in the previous sections, several SWMU/AOC-specific evaluations were completed in accordance with provisions of the QAPP. The results for each of these limited evaluations are provided below.

SWMU E Evaluation

In order to assess whether groundwater is being impacted by potential leakage from SWMU E, sampling results were evaluated for the two wells nearest the unit, i.e., RFIMW-1 and RFIMW-13. Because currently available data do not definitively indicate groundwater flow direction in this portion of the Facility, a pattern of radial flow was assumed. Accordingly, the results of one well were not compared against the results from the other (i.e., upgradient versus downgradient). Instead, both wells were considered as downgradient locations and their results compared against PSALs to determine whether potential impacts were occurring.

Few organic or inorganic constituents were detected above their respective quantitation limits in either RFIMW-1 or RFIMW-13. In fact, only two individual sampling results for two different metals (cadmium and zinc) exceeded PSALs. Based on the above results, it is concluded that leakage from SWMU E to groundwater is not occurring.

AOC 2 Evaluation

In conformance with the QAPP, one of the objectives for AOC 2 was to evaluate whether compounds of concern from the Old Coke Plant are migrating through groundwater to portions of the Facility not under hydraulic control by the groundwater extraction system. In order to determine whether such migration is occurring, it was first necessary to evaluate the likelihood that the operating extraction wells are attaining hydraulic control under the entire AOC. Having completed that analysis, it was then necessary to determine the known or likely direction of groundwater flow away from the unit, based upon a review of potentiometric surface maps. Once flow direction was determined to most likely be to the east, it was possible to select the downgradient well locations which most appropriately monitor groundwater leaving the vicinity of AOC 2. These locations, which lie along the eastern boundary of the unit, are RFIMW-15 and RFIMW-16.

Sample results from each of the two wells downgradient of AOC 2 were evaluated, focusing on constituents of concern which are typical of active or former coking operations. Neither volatile or semi-volatile compounds were detected at concentrations indicative of impacts to groundwater. Many of the constituents that were detected, in fact, were present below the quantitation limit. Thus, it does not appear that constituents of concern at this AOC are migrating to portions of the Facility not under hydraulic control of the groundwater extraction system.

AOC 7 Evaluation

In order to determine potential impacts to groundwater near AOC 7, sampling results from apparent downgradient locations RFIMW-23 and RFIMW-22 were compared against results from upgradient location RFIMW-24. Determination of gradients was made based upon a review of potentiometric surface maps for the Facility. These maps were prepared from water level elevation data collected during the four quarterly sampling events of the RFI.

Prior investigative work in the area of this AOC had indicated the presence of cyanide, PNAs and several metals in soils. During the RFI, groundwater samples were analyzed for the entire 40 CFR, Part 264, Appendix IX suite of parameters.

Sampling results indicate that groundwater quality in background well RFIMW-24 is good. Although several metals were detected, they were at low levels and never exceeded PSALs. Downgradient wells RFIMW-23 and RFIMW-22, on the other hand, yielded results that indicate an impact to groundwater in the vicinity of AOC 7. Samples from these two wells included a number of

PAHs and metals which consistently exceeded the PSALs during the four quarters of RFI groundwater sampling. Samples from RFIMW-23 also exceeded PSALs for total cyanide during each of the quarterly events.

AOC 9 Evaluation

AOC 9 is the site of a 1987 spill, during which 46,000 gallons of propylene oxide were released to soil. Remediation efforts were immediately implemented in response to the spill, and recovery efforts were deemed successful. Although no further investigation activities were required specifically for this AOC during the RFI, the QAPP did specify that propylene glycol and propylene oxide be included as target analytical parameters for the initial groundwater sampling event at monitoring wells RFIMW-2, RFIMW-14, TMW1, and TMW2.

A single well indicated the presence of propylene oxide in groundwater above its quantitative limit of 1 mg/L: TMW2 at 2 mg/L. Propylene glycol was not detected in any of the four wells sampled.

7.4.4 Summary of Groundwater Analytical Results

Groundwater analytical results indicate that COCs are present at scattered perimeter monitoring well locations across the Facility in concentrations which exceed PSALs. Monitoring wells along the northern portion of the Facility (RFIMW-22 in particular) exhibited the highest VOC and total cyanide concentrations. RFIMW-7 along the east central shoreline exhibited the highest 2-methylnaphthalene and naphthalene concentrations. Monitoring wells in the southeastern corner (RFIMW-11 and RFIMW-12) generally exhibited the highest metals concentrations.

As indicated by a review of groundwater flow characteristics in Section 7.1.4 (Figure 7-15), a component of groundwater flow is likely discharging to the river. However, quantitative determination of the groundwater discharge cannot be rendered using these data. Additional conclusions regarding the efficiency of the groundwater extraction system are provided in Section 9.2.

The groundwater extraction system has served to capture and reduce the constituents present in groundwater at the Facility. Table 7-48 presents an estimate of mass removal for those constituents which exceeded PSALs. The determination is based on 1) an approximate total groundwater removal volume of 25 million gallons (1987-1996); and 2) the use of overall mean groundwater concentrations for each constituent based on RFI results for the perimeter and non-network monitoring wells.

7.5 Groundwater Field Measurement Results

In addition to the collection of samples for laboratory analysis during three monthly and three quarterly Phase I RFI monitoring events, the following groundwater field parameters were also measured: pH, specific conductance, temperature, dissolved oxygen, and redox potential. These measurements are presented in Appendix E and summarized by parameter below.

pH values ranged site-wide from a low of 6.03 to a high of 13.97. In general, background values ranged from slightly acidic (pH 6.59) to slightly basic (pH 8.26). Most background values were in the pH 7.0 - 8.0 range. Downgradient interior and perimeter values ranged from slightly acidic (pH 6.03) to very basic (pH 13.97). Not significantly unlike those pH values obtained from upgradient wells, the majority of downgradient values were in the pH 6.0 - 8.0 range.

Historically high pH readings (i.e. pH > 12) were obtained from monitoring wells RFIMW-5, RFIMW-6, RFIMW-7, and RFIMW-12 alongside the river. In all likelihood, these readings reflect impacts of former site operations (recall that soda ash production has occurred at the Facility since the 1890s), but are not representative of a known impact from specific SWMUs . Most importantly, since the effects of atypical pH readings are not bioaccumulative in nature, these results and the associated risk are considered to be much less significant than results associated with chemical constituents. Additional results regarding groundwater characterization are more fully addressed in Section 7.1.4.

Specific conductance values (expressed as microsecals) as a group ranged site-wide from lows of approximately 1,000 to highs exceeding 80,000. Background wells did not demonstrate any consistent patterns, with one well producing among the lowest values site-wide and another well producing values among the highest. Monitoring well RFIMW-27 consistently exceeded all other background (and downgradient) wells, typically yielding values in the 60-80,000+ range. Consistent with upgradient wells, downgradient locations demonstrated wide value ranges, although extremes were not nearly as pronounced. Repeated relatively high conductance readings were generally obtained from two to three sampling points (RFIMW-1, RFIMW-2, PM1NA) in distinctly separate site locations.

Groundwater temperatures ranged site-wide from 3.8 - 24.0°C over the course of seasonal changes. Lowest values were recorded during the third quarterly event while the highest values were noted during the first monthly event. In general, variation among all wells during individual sampling events was 6°C or less.

Dissolved oxygen values (recorded in mg/L) ranged site-wide from lows of 0.0 to a one-time high of 7.1 in a single upgradient well and a one-time high of 18.6 in a downgradient well. In general, background groundwater values ranged between approximately 2.0 and 5.0. Downgradient interior and perimeter values were somewhat lower than upgradient values, generally ranging from 0.0 - 4.0.

Values for redox potential ranged site-wide from 280 to -374. In general, upgradient values ranged from the highest recorded positive of 280 to a moderately negative value of -183. Downgradient values demonstrated a broad variation from 262.1 to -374. With the exception of certain well locations in the fourth quarter sampling event, downgradient results were always negative values.

7.6 Stormwater Runoff Results

Stormwater runoff samples were collected and analyzed to 1) characterize runoff for potential suspended constituents, and 2) evaluate whether runoff represents a potential pathway of concern. Analytical results for the 3 stormwater runoff samples collected are summarized below. Sampling locations, selected constituent concentrations, and runoff patterns are displayed in Figure 7-34.

Due to the lack of any significant topography at the Facility, stormwater runoff sampling locations were selected on the basis of observations made during a heavy rain event. As a result, three locations were selected including: 1) one grab sample from the northern Facility boundary adjacent to AOC 7 (SW000AOC7), 2) one grab sample from the southeastern portion of the Facility along the shoreline to the east of AOC 6 (SW000AOC6), and 3) one grab sample from the western side of the Facility adjacent to the cemetery (SW000CEMT). The samples were collected from sheet-flow areas where shallow pooling had occurred. Analytical results for constituents detected in the stormwater runoff samples are summarized in Table 7-47.

Acetone was the only VOC detected in any of the runoff samples. Low concentrations of 13 ppm (estimated) and 10 ppm (estimated) were detected for samples SW000AOC6 and SW000AOC7, respectively. Neither of these concentrations exceeded the PSAL.

Eleven (11) metal constituents were detected in these samples. Metals constituents were detected at levels exceeding the associated PSALs in two of the three samples (SW000AOC6 and SW000AOC7). Runoff samples SW000AOC6 (0.062 ppm copper, 0.043 ppm lead, 0.00023 ppm mercury, 0.092 ppm vanadium, and 0.22 ppm zinc) and SW000AOC7 (0.051 ppm arsenic, 0.002 ppm cadmium, 0.12 ppm copper, 0.11 ppm lead, 0.00086 ppm mercury, 0.14 ppm vanadium, and 0.52 ppm zinc) contained metal concentrations which exceeded their respective PSALs.

Total cyanide was only detected in sample SW000AOC7 at a concentration of 0.016 ppm. This concentration does not exceed the applicable PSAL.

As a result, the following COCs were retained for evaluation in the preliminary risk assessment:

- Metals (7): arsenic, cadmium, copper, lead, mercury, vanadium, and zinc.

7.7 Results of Trenton Channel Sediment Study

As outlined in the RFI Workplan, BASF was required to evaluate sediment quality in the Trenton Channel (Channel) adjacent to the Facility. BASF acknowledges results of numerous reports and studies indicating that the quality of sediment, where present in various locations over the course of the Channel, has been negatively impacted over the last 100 years due to discharges from a variety of industrial and municipal sources. However, BASF has not focused on the degree to which sediments and associated contamination may or may not be present in the Channel, especially the stretch adjacent to the Facility. Anecdotal evidence (i.e., lack of regular dredging by the U.S. Army Corps of Engineers [COE] in the Channel near BASF) suggests significant sediment deposition has not been occurring. To most efficiently address this task, BASF first researched currently available data to evaluate the flow dynamics and sediment deposition characteristics within the Channel upstream, adjacent to, and downstream from the Facility. After the investigation to characterize the physical aspects was completed as described above, research and evaluation of available data regarding chemical characterization of the Channel sediments was conducted.

This section includes (1) documentation of the sediment conditions in the Channel adjacent to the Facility based on available research data/information, and (2) rationale that acquiring additional sediment sample data in the vicinity of the Facility would be an impractical/ineffectual process of limited utility.

7.7.1 Documentation of Surface Water Quality and Sediment Conditions in the Vicinity of the Facility

According to the *1996 Detroit River Remedial Action Plan (RAP) Report* (Contaminated Sediments Technical Workgroup), the sediments of the Detroit River have been ranked collectively (no individual sites) with a score of 34 out of a worst-case 48. Over the past century, this condition has resulted from discharges associated with various industrial and municipal outfalls. Per the RAP, the present status of Detroit River sediments is generally moderately to severely contaminated. Major improvements have not occurred during the past 5 to 10 years.

7.7.1.1 Surface Water and Sediment Quality

Sources of surface water pollution (and, to a degree, resultant associated sediment contamination) include direct outfalls to the Detroit River, direct outfalls to major tributaries, indirect outfalls through combined storm sewers, leachates and runoff from landfill or dredge spoil areas, atmospheric deposition of exhaust and stack emissions, and urban surface runoff. Although the principal sources of direct water pollution are reportedly the sewage treatment plant (STP) outfalls and combined storm sewer outfalls (CSOs), there is evidence that significant portions of industrial wastes are discharged to the river via the municipal STPs (*Volatile Halocarbons in the Detroit River and Their Relationship with Contaminant Sources*, Comba *et al*, 1985). These discharges from STPs contain significant contaminant loadings of industrial origin. Major STP sources are found upstream of and along the Channel and at the confluences of several tributaries (Ecorse River, River Rouge, Conners Creek, Little River, Turkey Creek). Notable industrial outfalls include, among others, the Detroit STP, Ford Canada, West Windsor STP, and Allied Chemical Canada. Michigan CSOs are cited as the primary origin of PCBs, cadmium, copper, mercury, lead, and zinc (*Results of Trenton Channel Project Sediment Surveys 1993-1996*, MDEQ and USEPA, July 1997). In addition to the source locations, a number of which are shown on Figure 7-35, approximately 50 CSOs are upstream of the Facility (*Volatile Halocarbons in the Detroit River and Their Relationship with Contaminant Sources*, Comba *et al.*, 1985).

Industry along the Detroit River has historically been comprised of the following:

- steel manufacturing;
- steel consuming industries, particularly the automotive industry;
- food and food processing;
- paper and associated products;
- chemical manufacturing;
- primary metal production and manufacturing;
- petroleum and coal processing;
- fluorocarbons;
- caustic soda and soda ash;
- rubber; and
- commercial shipping.

Results of various studies show that six major areas harbor the bulk of the sediment contamination. These areas are both upstream and downstream of the Facility. The areas include the Allied Fuel Oil Slip, Nicholson South Slip, Firestone Steel Area, Black Lagoon, Elizabeth Park North Canal, and Elizabeth Park South Canal-Inlet. Locations nearest the Facility are depicted on Figure 7-35. Sampling results indicate that mercury, PCBs, PAHs, heavy metals, and oil and grease are the primary parameters of concern in these locations (*Results of Trenton Channel Project Sediment Surveys 1993-1996*, MDEQ and U.S. EPA, July 1997). In addition, the sediment in Monguagon Creek is highly polluted with heavy metals such as mercury, chromium, zinc, and lead, and numerous organic contaminants including PCBs, phenols, heptachlor, hexachlorobenzene, and extractable oil and grease (1996 RAP). Remediation of Monguagon Creek began in January 1997 with a privately funded cleanup of approximately 20,000 cubic yards of sediment.

An extensive monitoring program for the Detroit River had previously served to assess water quality, estimate loadings, identify pollution "hot spots", and evaluate program effectiveness. However, the program is no longer in existence due to budget cuts and changing priorities. According to the *Detroit River Area of Concern Status Assessment* (International Joint Commission, 1997), Michigan DEQ and EPA Great Lakes National Program Office have recently undertaken work to further characterize the contaminated sediment problem within the Trenton Channel.

7.7.1.2 Sedimentation Characteristics within the Trenton Channel

The Trenton Channel represents the section of the Detroit River that flows between Grosse Ile and the Michigan mainland. It is approximately 9 miles in length and 0.15 to 0.75 miles wide. The average volumetric flow in the Channel is approximately 45,900 ft^3/second, which is about 25% of the river's total flow. Portions are dredged to maintain a depth of 23 to 30 feet for shipping passage. However, according to the COE, due to the lack of accumulated sediment, the portion of the Channel adjacent to the Facility has not required dredging for more than 10 years. As discussed in Section 7.7.2, this condition can be attributed to the flow conditions along this portion of the Channel.

The Channel is characterized by swift, laminar flow in its mid-portion; sand deposits occur in varying thicknesses along both shores where currents are slower. Fine-grained sediment thickness over bedrock reaches a maximum of 100 feet near Belle Island which is several miles upstream of the Facility, but decreases steadily southward to nearly zero in the vicinity of the Facility. As described in Section 7.7.2, there is no major depositional zone along the Michigan mainland shore from three-fourths of a mile upstream of BASF to the site of the former Firestone Steel facility, approximately three miles downstream (*Results of Trenton Channel Project Sediment Surveys 1993-1996*, MDEQ and USEPA, July 1997).

Significant sediment deposits, however, do accumulate in the lower reaches of the waterway where periodic dredging is required to maintain the shipping channels. These river sediments continuously shift and change in areas where velocities are moderate to high and at locations where passing freighters create disturbances which resuspend sediments. These conditions create shoaling in the dredged navigational channels and contribute to considerable downstream sediment transport. Polluted dredge materials are removed from the Trenton Channel and disposed of inside the COE's Confined Disposal Facility (CDF) at Pointe Mouillee, Michigan. Historically, polluted dredge materials from both the Trenton Channel and the River Rouge have been placed on Grassy Island and Mud Island, both of which are upstream from the Facility. Several reports cite these areas as potential sources of impact to environmental quality of the Channel.

7.7.1.3 Contaminant Distribution Trends

Although many of the contaminant distributions overlap considerably, several generalizations were identified regarding contaminant concentrations. The Allied Fuel Oil Slip and Nicholson South Slip mark the beginning of extreme sediment contamination in the Channel (see Figure 7-36). In general, levels in these two areas are much higher than those in immediate depositional zones downstream. Organic contaminants, PCBs, and oil and grease show a distinct decreasing trend of contamination from locations which are upstream from the Facility (Allied/Nicholson sites) to the Wyandotte Yacht Club, located immediately adjacent to and downstream of the Facility. Continuing downstream, a substantial increase in contamination begins again at Firestone Steel and continues down toward Monguagon Creek. In several sampling locations, highest concentrations are found primarily on the surface, suggesting localized, recent or continuing sources (*Results of Trenton Channel Project Sediment Surveys 1993-1996*, MDEQ and USEPA, July 1997).

Characterization of organic and heavy metal constituents within Trenton Channel sediments is presented in numerous reports, representative excerpts of which are summarized below.

<u>Organic Constituents</u>

Thirty-three sediment samples were collected in June-September 1986 and in June 1987 to evaluate four specific groups of organic contaminants in the Channel sediments (*Organic Contaminants in Sediments from the Trenton Channel of the Detroit River, Michigan*, Furlong *et al.*, 1988). None of the samples were collected near the shoreline of the Facility or adjacent to the Facility, presumably because of the low percentage of fine-grained sediments in the area. The nearest sampling locations included Station 901 (approximately 1.2 miles upstream from the Facility), Station 25 (approximately 0.9 miles downstream), and Station 111 (approximately 1.9 miles downstream).

The four major classes of organic contaminants are identified as:

- polycyclic aromatic hydrocarbons (PAHs);
- polychlorinated biphenyls (PCBs);
- polychlorinated naphthalenes (PCNs); and
- polychlorinated terphenyls (PCTs).

Reported PAH concentrations in sediments from the stations nearest the Facility ranged from 10 to 50 ug/g (dry weight). In general, the results indicated that the relative amounts of each PAH are similar across a wide range of absolute concentrations. The sediments are interpreted as being compositionally uniform, suggesting that there is either a single PAH source, multiple sources which are not significantly different from one another, or that the PAHs are well-mixed prior to sedimentary deposition (Furlong *et al*, 1988). The highest total PAH concentrations were detected from samples collected at Station 110 (summed PAH levels of 130,000 ng/g dry wt of sediment). Station 110 is

130 ppm

located approximately 3.4 miles downstream of the Facility and other intervening downstream potential sources.

13 ppm

The highest PCB levels were detected at Stations 77 and 107 (total summed PCBs of 13,000 and 14,000 ng/g, respectively) with significantly lower levels both upstream and downstream. Station 77 is approximately 2.5 miles downstream from the Facility. Station 107 is located approximately 5.6 miles downstream from the Facility near Elizabeth Park. Both sampling locations are downstream of multiple potential sources of PCB contamination. The distribution of PCBs is similar to that of total PAHs, possibly arising from input from upstream and within-Channel sources and fine-grained, PCB-enriched sediments concentrating in deposition zones.

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The highest PCN levels were detected from samples collected at Station 110 (total summed PCN concentrations of 61,000 ng/g, respectively) with high concentrations just downstream of the station. Station 110 is adjacent to a closed steel products factory. Samples upstream show negligible (0 to 10 ng/g) PCN concentrations.

The highest PCT levels also occur at Station 110 (total summed PCT concentrations of 2,500 ng/g) with undetectable concentrations upstream and downstream of the Channel.

Inorganic Constituents

In 1985, sampling at 47 stations throughout the Detroit River from Lake St. Clair to Lake Erie indicated moderate to heavy pollution at 29 stations (Nichols *et al*, 1991). The sediments at Stations 230 and 236 (approximately 5 and 7.5 miles downstream from the Facility, respectively) were heavily polluted with all seven metals analyzed (mercury, cadmium, chromium, copper, lead, nickel and zinc). However, heavy pollution also exists upstream from the Facility. As discussed previously, CSOs have been identified as major sources of such impacts.

The following mean metals concentrations (ug/g dry weight sediment) were determined based on the analysis of 47 sediment samples collected from the Detroit River both upstream and downstream of the Facility: 1.61 ug/g mercury, 1.99 ug/g cadmium, 37.01 ug/g chromium, 38.23 ug/g copper, 27.24 ug/g nickel, 65.57 ug/g lead, and 272.70 ug/g zinc.

Although the studies indicated that pollution was heaviest near the industrialized areas, metal contaminants from these areas were also concentrated in sediment deposition zones as far as 37 miles downstream from any known source of pollution (Nichols *et al*, 1991).

Additionally, data from a cooperative USEPA effort were evaluated. The effort was completed in conjunction with the U.S. Army Corps of Engineers, MDEQ, and Eastern Michigan University to develop a GIS system for managing, analyzing, and visualizing contaminated sediments in the waters of the Great Lakes. None of the samples were collected near the shoreline of the Facility or adjacent to the Facility, presumably because of the low percentage of fine-grained sediments in the area.

7.7.2 Utility of Sediment Sampling Adjacent to the Facility

As documented in prior studies, flow dynamics and the limited potential for sediment deposition in the Channel adjacent to the Facility present significant deterrents to evaluating sediment presence, let alone conducting its satisfactory characterization.

The mid portion of the Channel, where the current is swiftest, is underlain with boulders and gravel. Both shores of the Channel, where currents are somewhat slower, can have deposits of fine-grained sediment. When evaluated in its entirety, the Channel is considered to be a major depositional area within the Detroit River. However, MDNR staff have verified that the flowrates are significantly higher in the upper reaches of the Channel between the BASF Facility and Grassy Island than for lower portions of the Channel. In fact, according to the MDNR document, *Results of Trenton Channel Project Sediment Surveys 1993-1996*, there is no major depositional zone along the Michigan mainland shore from the Wyandotte Yacht Club to the site of the former Firestone Steel (a distance of two and one-half miles). The Facility is located immediately adjacent to (upstream of) the yacht club. The report further concludes that there are only a few depositional zones from Ecorse River (approximately three-fourths mile upstream of BASF) to the Gross Ile Toll Bridge, which is located close to three miles downstream.

It should also be noted that a direct correlation exists between the type of depositional material present and the propensity of organic and inorganic contaminants to partition to such materials. In general, depositional materials with a higher percentage of fines and organic carbon content (e.g., silts, clays) will be more attractive to contaminants than will coarser materials such as sands. With the exception of a few back eddies, depositional materials in the study area have been shown to consist primarily of sand with a very low percentage of fines.

In addition to the flow dynamics and sediment deposition characteristics adjacent to the Facility, uncertainty associated with identifying the specific origins of historic pollutants in a heavily industrialized area such as that upstream of BASF also presents a significant deterrent at attempts of accurate, meaningful sediment characterization. Pollution of the Detroit River and Trenton Channel over the past 100 years can be attributed to many diverse point and diffuse sources as previously discussed.

An evaluation of published analytical data from several research projects indicates that contamination from these sources is neither easily nor reliably traced back to its exact origins. The compounding effects of multiple sources, long operational periods, and dynamic transport mechanisms makes accurate determination of environmental fate and transport pathways difficult, although some reasonable hypotheses can be put forth. For instance, results from a 1985 study of sediment samples adjacent to 250 stations along the Detroit River indicate that while pollution was heaviest near industrial areas, metal contaminants likely originating from these areas were also concentrated in sediment deposition areas as far as 37 miles downstream from potential pollution sources (Nichols *et al*, 1991). In addition, other studies indicate PCB contamination both upstream and downstream of the Channel. This phenomenon suggests that contamination in Channel sediment may originate from resuspension and transport of previously impacted materials (Furlong *et al*, 1988). While further analytical characterization of sediments could serve to validate existing datasets, it is clear that, given the types of constituents present at the Facility and in the Channel as well as their behavior in the environment, collection and analysis of sediment samples would provide little more than basis for speculation as to the exact origins of detected pollutants.

In summary, it is highly probable that any efforts to acquire further sediment data in the vicinity of the Facility would prove of limited utility. Sampling attempts may not result in the collection of sufficient representative analyzable samples due to the low percentage of fine-grained sediment deposits in the area. In fact, even if samples could be collected, due to the extent of pollution throughout the Channel and the diversity of pollutant sources there is little reason to believe that sediment sampling in the vicinity of the Facility would yield data substantial enough to draw any meaningful conclusions regarding the origin of detected pollutants. Any such work would more appropriately be conducted as a component of U.S. EPA/MDNR activities which focus on the Detroit River AOC.

TABLE 7-1

Constituent Concentrations and Statistical Values for Background Fill Samples
BASF - Wyandotte RFI

		SAMPLE ID NUMBERS AND RESULTS					STATISTICAL VALUES			
CONSTITUENT	UNITS	SG001RFIMW24	SG001RFIMW25	SG002RFIMW26	SG001RFIMW27	SG002RFIMW28	MEAN (1)	STD DEV	COEFF OF VAR	MEAN + 3 STD DEV (2)
Semi-Volatile Organics										
Acenaphthene	ug/kg	380 U	370 U	360 U	490 U	750 U	470			
Acenaphthylene	ug/kg	380 U	370 U	360 U	490 U	750 U	470			
Acetophenone	ug/kg	380 U	370 U	360 U	490 U	750 U	470			
Anthracene	ug/kg	380 U	370 U	69 J	490 U	750 U	213	111	0.5	546
Benzo(a)anthracene	ug/kg	71 J	350 J	650	490 U	750 U	338	211	0.6	972
Benzo(b)fluoranthene	ug/kg	210 J	730	810	490 U	750 U	474	279	0.6	1,310
Benzo(k)fluoranthene	ug/kg	38 J	200 J	250 J	490 U	750 U	222	122	0.5	586
Benzo(ghi)perylene	ug/kg	54 J	360 J	360	490 U	750 U	279	136	0.5	687
Benzo(a)pyrene	ug/kg	47 J	310 J	570	490 U	750 U	309	191	0.6	881
Benzyl alcohol	ug/kg	380 U	370 U	360 U	490 U	750 U	470			
Butyl benzyl phthalate	ug/kg	380 U	370 U	360 U	490 U	750 U	470			
bis(2-Chloroethyl) ether	ug/kg	380 U	370 U	360 U	490 U	750 U	470			
bis(2-Chloroisopropyl) ether	ug/kg	380 U	370 U	360 U	490 U	750 U	470			
4-Chloro-3-methylphenol	ug/kg	380 UR	370 U	360 U	490 U	750 U	470			
2-Chlorophenol	ug/kg	380 UR	370 U	360 U	490 U	750 U	470			
Chrysene	ug/kg	65 J	310 J	510	490 U	750 U	301	164	0.5	794
Dibenz(a,h)anthracene	ug/kg	380 U	50 J	84 J	490 U	750 U	189	130	0.7	580
Dibenzofuran	ug/kg	380 U	370 U	74 J	490 U	750 U	214	109	0.5	542
Diethyl phthalate	ug/kg	380 U	370 U	240 J	490 U	750 U	247	77	0.3	477
2,4-Dimethylphenol	ug/kg	380 UR	370 U	360 U	490 U	750 U	470			
2,4-Dinitrotoluene	ug/kg	380 U	370 U	360 U	490 U	750 U	470			
Di-n-octyl phthalate	ug/kg	380 U	370 U	360 U	490 U	750 U	470			
1,4-Dioxane	ug/kg	1800 U	1800 U	1800 U	2400 U	3600 U	2,280			
bis(2-Ethylhexyl) phthalate	ug/kg	380 U	370 U	360 U	490 U	750 U	470			
Fluoranthene	ug/kg	120 J	640	790	490 U	750 U	434	277	0.6	1,265
Fluorene	ug/kg	380 U	370 U	360 U	490 U	750 U	470			
Indeno(1,2,3-cd)pyrene	ug/kg	39 J	300 J	360	490 U	750 U	264	136	0.5	671
2-Methylnaphthalene	ug/kg	83 J	370 U	220 J	490 U	750 U	222	106	0.5	538
2-Methylphenol	ug/kg	380 UR	370 U	360 U	490 U	750 U	470			
3-Methylphenol	ug/kg	380 UR	370 U	360 U	490 U	750 U	470			
4-Methylphenol	ug/kg	380 UR	370 U	360 U	490 U	750 U	470			
Naphthalene	ug/kg	380 U	370 U	150 J	490 U	750 U	229	88	0.4	494
4-Nitrophenol	ug/kg	1800 UR	1800 U	1800 U	2400 U	3600 U	2,280			
N-Nitrosodi-n-propylamine	ug/kg	380 U	370 U	360 U	490 U	750 U	470			
Pentachlorophenol	ug/kg	5.7 U	5.6 U	5.5 U	7.4 U	11 U	7			
Phenanthrene	ug/kg	77 J	210 J	400	490 U	750 U	261	131	0.5	656
Phenol	ug/kg	380 UR	370 U	360 U	490 U	750 U	470			
Pyrene	ug/kg	110 J	650	780	490 U	750 U	432	279	0.6	1,268
1,2,4-Trichlorobenzene	ug/kg	380 U	370 U	360 U	490 U	750 U	470			
Metals/Inorganics										
Antimony	mg/kg	2.3 UJ	0.56 UJ	0.57 U*	0.74 UJ	1.1 UJ	1.1			
Arsenic	mg/kg	8	6	9.5	7.4	8.9	8.0	1.4	0.2	12.0
Barium	mg/kg	97	101	33.5	80.7	179	98.2	52.5	0.5	255.8
Beryllium	mg/kg	0.57 UJ	0.56 U	0.55 U	0.74 U	1.1	0.5	0.4	0.8	1.5
Cadmium	mg/kg	1.4	0.28	0.62	0.29	0.23 U	0.5	0.5	1.0	2.1
Chromium (3)	mg/kg	841	9	15.6	9.7	16.1	12.6	3.8	0.3	23.9
Cobalt	mg/kg	5.7 U	5.6 U	6.1	7.4 U	11.3 U	4.2	1.6	0.4	8.9
Copper	mg/kg	29.7	8.1	25.7	12.4	12	17.6	9.5	0.5	46.1
Lead	mg/kg	33.4	12.8	32	2.2	1.1 J	16.3	15.7	1.0	63.3
Mercury	mg/kg	0.11 U	0.16	0.27	0.52	0.23 U	0.2	0.2	0.8	0.8
Nickel	mg/kg	13.9 J	6.8 J	14.2 J	12.8 J	14.8 J	12.5	3.3	0.3	22.3
Selenium	mg/kg	4.6 U	0.56 U	1.2	0.74 U	1.1 U	0.9	0.8	0.9	3.5
Silver	mg/kg	9.2 U	1.1 U	1.1 U	1.5 U	2.3 U	3.0			
Thallium	mg/kg	9.2 U	1.1 U	1.1 U	1.5 U	2.3 U	3.0			
Tin	mg/kg	114 U	113 U	110 U	148 U	226 U	142.2			
Total Cyanide	mg/kg	2.7	1.9	3.7	0.78	0.56 U	1.9	1.4	0.7	6.0
Vanadium (3)	mg/kg	222	12.1	17	23.5	27.9	20.1	7.0	0.3	41.1
Zinc	mg/kg	116	40	58.1	134	117	93.0	41.3	0.4	216.8

Notes:

- U This compound was not detected at or above the associated numerical value. (Quantitation limit shown.)
- U* This compound should be considered "not detected" since it was detected in a blank at a similar level. (Quantitation limit shown.)
- J Quantitation is approximate due to limitations identified during the quality assurance review (data validation).
- UJ This compound was not detected, but the quantitation limit is probably higher due to a low bias identified during the quality assurance review. (Quantitati
- UR Unusable "not detected" result; compound may or may not be present in this sample. (Quantitation limit shown.)

(1) Background level is represented by "mean" value in instances where concentrations for all background fill samples were less than the quantitation limit.
(2) Background level is represented by "mean + 3 standard deviation" value in instances where an analyte was detected in at least one of the five background fill samples.
(3) Refined statistical values for chromium and vanadium exclude outlier data from sample number SG001RFIMW24.

TABLE 7-2

Constituent Concentrations and Statistical Values for Background Sand Samples
BASF - Wyandotte RFI

CONSTITUENT	UNITS	SAMPLE ID NUMBERS AND RESULTS: SG004RFIMW24	SG005RFIMW25	SG005RFIMW26 (MS/MSD)	SG013RFIMW27	SG007RFIMW28	STATISTICAL VALUES: MEAN (1)	STD DEV	COEFF OF VAR	MEAN + 3 STD DEV (2)
Semi-Volatile Organics										
Acenaphthene	ug/kg	430 U	400 U	390 U	420 U	400 U	408			
Acenaphthylene	ug/kg	430 U	400 U	390 U	420 U	400 U	408			
Acetophenone	ug/kg	430 U	400 U	390 U	420 U	400 U	408			
Anthracene	ug/kg	430 U	400 U	390 U	420 U	400 U	408			
Benzo(a)anthracene	ug/kg	430 U	400 U	40 J	420 U	400 U	173	75	0.4	397
Benzo(b)fluoranthene	ug/kg	430 U	400 U	390 U	420 U	400 U	408			
Benzo(k)fluoranthene	ug/kg	430 U	400 U	390 U	420 U	400 U	408			
Benzo(ghi)perylene	ug/kg	430 U	400 U	390 U	420 U	400 U	408			
Benzo(a)pyrene	ug/kg	430 U	400 U	390 U	420 U	400 U	408			
Benzyl alcohol	ug/kg	430 U	400 U	390 U	420 U	400 U	408			
Butyl benzyl phthalate	ug/kg	430 U	400 U	390 U	420 U	400 U	408			
bis(2-Chloroethyl) ether	ug/kg	430 U	400 U	390 U	420 U	400 U	408			
bis(2-Chloroisopropyl) ether	ug/kg	430 U	400 U	390 U	420 U	400 U	408			
4-Chloro-3-methylphenol	ug/kg	430 U	400 U	390 U	420 U	400 U	408			
2-Chlorophenol	ug/kg	430 U	400 U	390 U	420 U	400 U	408			
Chrysene	ug/kg	430 U	400 U	45 J	420 U	400 U	174	72	0.4	391
Dibenz(a,h)anthracene	ug/kg	430 U	400 U	390 U	420 U	400 U	408			
Dibenzofuran	ug/kg	430 U	400 U	390 U	420 U	400 U	408			
Diethyl phthalate	ug/kg	430 U	400 U	390 U	420 U	400 U	408			
2,4-Dimethylphenol	ug/kg	430 U	400 U	390 U	420 U	400 U	408			
2,4-Dinitrotoluene	ug/kg	430 U	400 U	390 U	420 U	400 U	408			
Di-n-octyl phthalate	ug/kg	430 U	400 U	390 U	420 U	400 U	408			
1,4-Dioxane	ug/kg	2100 U	1900 U	1900 U	2000 U	1900 U	1,960			
bis(2-Ethylhexyl) phthalate	ug/kg	430 U	400 U	390 U	420 U	400 U	408			
Fluoranthene	ug/kg	430 U	400 U	68 J	420 U	400 U	179	62	0.3	365
Fluorene	ug/kg	430 U	400 U	390 U	420 U	400 U	408			
Indeno(1,2,3-cd)pyrene	ug/kg	430 U	400 U	390 U	420 U	400 U	408			
2-Methylnaphthalene	ug/kg	430 U	400 U	390 U	420 U	400 U	408			
2-Methylphenol	ug/kg	430 U	400 U	390 U	420 U	400 U	408			
3-Methylphenol	ug/kg	430 U	400 U	390 U	420 U	400 U	408			
4-Methylphenol	ug/kg	430 U	400 U	390 U	420 U	400 U	408			
Naphthalene	ug/kg	430 U	400 U	390 U	420 U	400 U	408			
4-Nitrophenol	ug/kg	2100 U	1900 U	1900 U	2000 U	1900 U	1,960			
N-Nitrosodi-n-propylamine	ug/kg	430 U	400 U	390 U	420 U	400 U	408			
Pentachlorophenol	ug/kg	6.5 U	6.1 U	5.9 U	6.3 U	6 U	6			
Phenanthrene	ug/kg	430 U	400 U	390 U	420 U	400 U	408			
Phenol	ug/kg	430 U	400 U	390 U	420 U	400 U	408			
Pyrene	ug/kg	430 U	400 U	70 J	420 U	400 U	179	61	0.3	363
1,2,4-Trichlorobenzene	ug/kg	430 U	400 U	390 U	420 U	400 U	408			
Metals/Inorganics										
Antimony	mg/kg	0.65 UJ	0.61 UJ	0.59 UJ	0.63 UJ	0.6 UJ	0.6			
Arsenic	mg/kg	1.4	1.8	5.1	2.5	1.8	2.5	1.5	0.6	7.0
Barium	mg/kg	7.3	7.7 J	12.4	18.1	6	10.3	5.0	0.5	25.3
Beryllium	mg/kg	0.65 U	0.61 U	0.59 U	0.63 U	0.6 U	0.6			
Cadmium	mg/kg	0.13 U	0.12 U	0.12 U	0.13 U	0.12 U	0.1			
Chromium	mg/kg	8.5	6.6	4.5	9	5.4	6.8	1.9	0.3	12.6
Cobalt	mg/kg	6.5 U	6.1 U	5.9 U	6.3 U	6 U	6.2			
Copper	mg/kg	3.3	2.7	3.4	6.2	6.9	4.5	1.9	0.4	10.2
Lead	mg/kg	2.7	2.2	2.3	3.1	2.5	2.6	0.4	0.1	3.6
Mercury	mg/kg	0.13 U	0.12 U	0.12 U	0.13 U	0.12 U	0.1			
Nickel	mg/kg	5.2 U	4.9 U	4.8 U	6.4 J	5.7 J	3.9	2.0	0.5	9.8
Selenium	mg/kg	0.65 U	0.61 U	0.59 U	0.63 U	0.6 U	0.6			
Silver	mg/kg	1.3 U	1.2 U	1.2 U	1.3 U	1.2 U	1.2			
Thallium	mg/kg	1.3 U	1.2 U	1.2 U	1.3 U	1.2 U	1.2			
Tin	mg/kg	129 U	122 U	119 U	126 U	120 U	123.2			
Total Cyanide	mg/kg	0.39	1.1 J	0.3 U	0.32 U	0.3 U	0.4	0.4	1.1	1.6
Vanadium	mg/kg	13.2	9	5.9	20.2	12.4	12.1	5.4	0.4	28.2
Zinc	mg/kg	10.2	13.4	9.6	12.5	15.4	12.2	2.4	0.2	19.3

Notes:

U This compound was not detected at or above the associated numerical value. (Quantitation limit shown.)
J Quantitation is approximate due to limitations identified during the quality assurance review (data validation).
UJ This compound was not detected, but the quantitation limit is probably higher due to a low bias identified during the quality assurance review. (Quantitatio

(1) Background level is represented by "mean" value in instances where concentrations for all background fill samples were less than the quantitation limit.
(2) Background level is represented by "mean + 3 standard deviation" value in instances where an analyte was detected in at least one of the five background fill samples.

TABLE 7-3

Detected Constituent Concentrations for SWMU F Soil Samples
BASF - Wyandotte RFI

CONSTITUENT	UNITS	SG005SWMUF-SP01	SG002SWMUF-SP02	SG006SMWUF-SP03	SG006SMWUF-SP04	SG010SWMUF-SP06	SG005SWMUF-SP07	SG004SWMUF-SP08	SG004SWMUF-SP09 (MS/MSD)	SG006SWMUF-SP11	SG011SWMUF-SP18	*PRELIMINARY SITE-SPECIFIC ACTION LEVEL (PSAL) (1)*
		SAMPLE ID NUMBERS AND RESULTS										
Volatile Organics												
Acetone	ug/kg	50000	82 U	22000 J	25000 J	75000	190000	190 J	56000	28000	6300 J	*500,000*
Benzene	ug/kg	1900 U	8.2 U	2000 J	1600 U	2900 U	6700 U	11 U	1700 U	920 U	1100 U	*1,060*
1,2-Dichloropropane	ug/kg	1900 U	4.2 J	70000	8600	11000	6700 U	11 U	1700 U	920 U	760 J	*1,280*
Methyl ethyl ketone	ug/kg	19000 U	82 U	36000 U	16000 U	29000 U	67000 U	17 J	17000 U	9200 U	11000 U	*144,000*
Toluene	ug/kg	55000	11	110000	21000	6200	48000	11	1700 U	920 U	1100 U	*2,200*
m-Xylene & p-Xylene	ug/kg	1900 U	8.1 J	3600 U	1600 U	2900 U	6700 U	11 U	1700 U	920 U	1100 U	*1,180*
Semi-Volatile Organics												
Acenaphthene	ug/kg	4000 U	540 U	19000 U	17000 U	15000 U	2100 U	440 J	460 U	490 U	570 U	*470*
Anthracene	ug/kg	4000 U	540 U	19000 U	17000 U	15000 U	2100 U	1300 J	110 J	490 U	570 U	*2,200,000*
Benzo(a)anthracene	ug/kg	4000 UJ	540 U	19000 UJ	17000 UJ	15000 UJ	1700 J	1300 J	350 J	490 UJ	120 J	*972*
Benzo(a)pyrene	ug/kg	4000 UJ	540 UJ	19000 UJ	17000 UJ	15000 UJ	1600 J	630 J	460 U	490 UJ	120 J	*881*
Benzo(b)fluoranthene	ug/kg	4000 UJ	540 UJ	19000 UJ	17000 UJ	15000 UJ	1500 J	940 J	530	490 UJ	150 J	*1,310*
Benzo(ghi)perylene	ug/kg	4000 UJ	540 UJ	19000 UJ	17000 UJ	15000 UJ	850 J	1700 U	59 J	490 UJ	150 J	*687*
Benzo(k)fluoranthene	ug/kg	4000 UJ	540 UJ	19000 UJ	17000 UJ	15000 UJ	890 J	340 J	130 J	490 UJ	82 J	*586*
Benzyl alcohol	ug/kg	4000 U	540 U	19000 U	17000 U	21000	2100 U	1700 U	460 U	490 U	570 U	*470*
Butyl benzyl phthalate	ug/kg	4000 UJ	540 U	19000 UJ	17000 UJ	15000 UJ	1000 J	1700 U	460 U	490 UJ	570 UJ	*930,000*
bis(2-Chloroisopropyl) ether	ug/kg	4000 U	540 U	28000	15000 J	7600 J	2100 U	290 J	700	490 U	2600	*6,700*
Chrysene	ug/kg	4000 UJ	540 U	19000 UJ	17000 UJ	15000 UJ	1700 J	1100 J	310 J	490 UJ	160 J	*794*
Dibenzofuran	ug/kg	4000 U	540 U	19000 U	17000 U	15000 U	2100 U	370 J	120 J	490 U	570 U	*260,000*
2,4-Dimethylphenol	ug/kg	4000 U	540 U	19000 U	17000 U	15000 U	22000	1700 U	460 U	490 U	570 U	*600*
Di-n-octyl phthalate	ug/kg	4000 UJ	540 UJ	19000 UJ	17000 UJ	15000 J	2100 UJ	1700 U	460 U	490 UJ	570 UJ	*10,000,000*
Fluoranthene	ug/kg	4000 U	63 J	19000 U	17000 U	15000 U	2200	4500	750	490 U	200 J	*7,400*
Fluorene	ug/kg	4000 U	540 U	19000 U	17000 U	15000 U	2100 U	780 J	170 J	490 U	570 U	*280,000*
Indeno(1,2,3-cd)pyrene	ug/kg	4000 UJ	540 UJ	19000 UJ	17000 UJ	15000 UJ	2100 UJ	1700 U	460 U	490 UJ	100 J	*671*
2-Methylnaphthalene	ug/kg	4000 U	540 U	19000 U	17000 U	15000 U	2100 U	730 J	130 J	490 U	150 J	*680*
2-Methylphenol	ug/kg	4000 U	540 U	19000 U	17000 U	15000 U	4100	1700 U	460 U	490 U	570 U	*760*
3-Methylphenol	ug/kg	4000 U	540 U	19000 U	17000 U	15000 U	20000 JN	1700 U	310 JN	580 JN	200 JN	*2,000,000*
4-Methylphenol	ug/kg	4000 U	540 U	19000 U	17000 U	15000 U	20000 JN	1700 U	310 JN	580 JN	200 JN	*124*
Naphthalene	ug/kg	4000 U	540 U	19000 U	17000 U	15000 U	450 J	340 J	99 J	490 U	140 J	*680*
Pentachlorophenol	ug/kg	16	8.2 U	11 U	13 U	11 U	64 J	6.5 U	7 U	7.4 U	8.7 U	*16*
Phenanthrene	ug/kg	4000 U	540 U	19000 U	17000 U	15000 U	1600 J	6000	790	490 U	200 J	*656*
Phenol	ug/kg	4000 U	540 U	19000 U	17000 U	15000 U	6400	1700 U	460 U	1900	570 U	*22,000*
Pyrene	ug/kg	4000 UJ	540 U	19000 UJ	17000 UJ	15000 UJ	3400 J	2900	890	490 UJ	400 J	*220,000*
Pesticides												
Aroclor 1254	ug/kg	500 UR	540 UJ	750 U	860 UR	750 U	2800 J	430 U	460 U	490 U	570 UJ	*2.0E-05*
4,4'-DDE	ug/kg	5 UR	5.4 UJ	7.5 U	17 UR	38 U	54 U	43 U	46 U	4.9 U	7.8 J	*0.12*
Metals/Inorganics												
Antimony	mg/kg	0.76 UJ	0.82 UJ	1.1 UJ	1.3 UJ	1.1 UJ	16 J	0.71 J	0.77 J	0.74 UJ	0.87 UJ	*1.1*
Arsenic	mg/kg	12.3	22.9	14.7 J	4.4 J	12.2	62	28.4	63.9	5.7	5.8	*12.0*
Barium	mg/kg	32.4	79.2	96.8 J	41.3 J	159	491	71.5	59.5	30	18.8	*255.8*
Cadmium	mg/kg	0 3	0.6	0.67	0.28	0.75	7.3	0.69	0.65	0.48	0.27	*2.1*
Chromium	mg/kg	6.4	16.4	15.7	8.4	18.7	130	8.9	17.6	8.6	7.7	*23.9*
Cobalt	mg/kg	7.6 U	8.2 U	11.4 U	13.1 U	11.4 U	40.5	6.5 U	7 U	7.4 U	8.7 U	*8.9*
Copper	mg/kg	10.5	26.9	32.8	11.3	62.8	7710	23.3	22.9	19.6	11.9	*46.1*
Lead	mg/kg	3.6	12.6	57.5 J	15.5 J	64.3	876	32.3	21	1.5	10.3	*63.3*
Mercury	mg/kg	0.15 UJ	0.33 J	3.5 J	0.35 J	2.2	21.1	0.13 UJ	1.2	0.15 UJ	0 17 UJ	*0.8*
Nickel	mg/kg	8.6	23.4	20 J	10.5 UJ	15.8	170	11.3	13.5	6.4	7.7	*22.3*
Selenium	mg/kg	0.76 U	0.82 U	1.2 J	1.3 UJ	1.8	6.3	3.2	1.5	0.74 U	0 87 U	*3.5*
Silver	mg/kg	1.5 U	1.6 U	2.3 U	2.6 U	2.3 U	10.5	1.3 U	1.4 U	1.5 U	1.7 U	*3.0*
Tin	mg/kg	153 U	164 U	228 UJ	262 UJ	228 U	424	130 U	139 U	148 U	174 U	*46,000.0*
Total Cyanide (2)	mg/kg	0.38 U	1.7	2.6	2.3	5.1	4.9	0.32 U	1.1	2.2	1.7	*0.1*
Vanadium	mg/kg	12.1	20.7	21.1	13.1 U	19.6	23.3	15.7	14.4	17.4	9.3	*41.1*
Zinc	mg/kg	7.6 UJ	53.2 J	111 J	52.4 J	147 J	1000 J	34.7 J	97 J	72.9 J	61.5 J	*216.8*

Notes:

U This compound was not detected at or above the associated numerical value. (Quantitation limit shown.)
J Quantitation is approximate due to limitations identified during the quality assurance review (data validation)
UJ This compound was not detected, but the quantitation limit is probably higher due to a low bias identified during the quality assurance review. (Quantitation limit shown.)
UR Unusable "not detected" result; compound may or may not be present in this sample. (Quantitation limit shown.)
JN Quantitation is approximate due to limitations identified during the quality assurance review (data validation). This result should be considered a tentative qualitative identification.

(1) Appropriate Preliminary Site-specific Action Levels (PSALs) for fill were utilized.
(2) Analytical data for total cyanide could only be compared to the more conservative PSAL for amenable cyanide
Shaded values indicate constituent concentrations which exceed the preliminary site-specific action levels

TABLE 7-4
80% UCL Concentrations for SWMU F Soil Samples
BASF - Wyandotte RFI

CONSTITUENT	UNITS	80% UCL (1)	PRELIMINARY SITE-SPECIFIC ACTION LEVEL (PSAL) (2)	80% UCL EXCEED PSAL?
Volatile Organics				
Acetone	ug/kg	61,053	500,000	NO
Benzene	ug/kg	1,325	1,060	YES
1,2-Dichloropropane	ug/kg	15,621	1,280	YES
Methyl ethyl ketone	ug/kg	12,994	144,000	NO
Toluene	ug/kg	34,425	2,200	YES
m-Xylene & p-Xylene	ug/kg	1,300	1,180	YES
Semi-Volatile Organics				
Acenaphthene	ug/kg	4,080	470	YES
Anthracene	ug/kg	4,142	2,200,000	NO
Benzo(a)anthracene	ug/kg	4,203	972	YES
Benzo(a)pyrene	ug/kg	4,130	881	YES
Benzo(b)fluoranthene	ug/kg	4,172	1,310	YES
Benzo(ghi)perylene	ug/kg	4,073	687	YES
Benzo(k)fluoranthene	ug/kg	4,035	586	YES
Benzyl alcohol	ug/kg	6,293	470	YES
Butyl benzyl phthalate	ug/kg	4,109	930,000	NO
bis(2-Chloroisopropyl) ether	ug/kg	8,317	6,700	YES
Chrysene	ug/kg	4,187	794	YES
Dibenzofuran	ug/kg	4,066	260,000	NO
2,4-Dimethylphenol	ug/kg	7,099	600	YES
Di-n-octyl phthalate	ug/kg	5,264	10,000,000	NO
Fluoranthene	ug/kg	4,577	7,400	NO
Fluorene	ug/kg	4,103	280,000	NO
Indeno(1,2,3-cd)pyrene	ug/kg	4,099	671	YES
2-Methylnaphthalene	ug/kg	4,085	680	YES
2-Methylphenol	ug/kg	4,403	760	YES
3-Methylphenol	ug/kg	6,778	2,000,000	NO
4-Methylphenol	ug/kg	6,778	124	YES
Naphthalene	ug/kg	4,001	680	YES
Pentachlorophenol	ug/kg	17	16	YES
Phenanthrene	ug/kg	4,714	656	YES
Phenol	ug/kg	4,797	22,000	NO
Pyrene	ug/kg	4,567	220,000	NO
Pesticides				
Aroclor 1254	ug/kg	848	2.0E-05	YES
4,4'-DDE	ug/kg	16	0.12	YES
Metals/Inorganics				
Antimony	mg/kg	3.4	1.1	YES
Arsenic	mg/kg	29.4	12.0	YES
Barium	mg/kg	147.2	255.8	NO
Cadmium	mg/kg	1.8	2.1	NO
Chromium	mg/kg	34.3	23.9	YES
Cobalt	mg/kg	11.3	8.9	YES
Copper	mg/kg	1471.8	46.1	YES
Lead	mg/kg	184.9	63.3	YES
Mercury	mg/kg	4.7	0.8	YES
Nickel	mg/kg	42.2	22.3	YES
Selenium	mg/kg	2.1	3.5	NO
Silver	mg/kg	2.7	3.0	NO
Tin	mg/kg	153.8	46,000.0	NO
Total Cyanide (3)	mg/kg	2.7	0.1	YES
Vanadium	mg/kg	17.5	41.1	NO
Zinc	mg/kg	246.2	216.8	YES

(1) 80% UCL = Mean + 0.883(Standard Deviation/n^0.5), where n=10
(2) Appropriate Preliminary Site-specific Action Levels (PSALs) for fill were utilized.
(3) Analytical data for total cyanide could only be compared to the more conservative PSAL for amenable cyanide.

TABLE 7-5

Detected Constituent Concentrations for SWMU G Soil Samples
BASF - Wyandotte RFI

CONSTITUENT	UNITS	SAMPLE ID NUMBERS AND RESULTS										PRELIMINARY SITE-SPECIFIC ACTION LEVEL (PSAL) (1)
		SS001 SWMUG-1	SS001 SWMUG-2	SS001 SWMUG-3	SS001 SWMUG-4	SS001 SWMUG-5	SS001 SWMUG-6	SS001 SWMUG-7 (MS/MSD)	SS001 SWMUG-8	SS001 SWMUG-9	SS001 SWMUG-10	
Semi-Volatile Organics												
Acenaphthene	ug/kg	400 U	450 U	43 J	3700 U	370 U	38 J	410 U	400 U	1600 U	400 U	*470*
Acenaphthylene	ug/kg	52 J	120 J	44 J	490 J	150 J	59 J	120 J	92 J	1800	400 U	*470*
Anthracene	ug/kg	51 J	170 J	100 J	3700 U	90 J	200 J	78 J	61 J	700 J	400 U	*2,200,000*
Benzo(a)anthracene	ug/kg	390 J	660	640	740 J	440	740	580	450	3200	400 U	*972*
Benzo(a)pyrene	ug/kg	310 J	540	530	990 J	420	440	470	410	3700	400 U	*881*
Benzo(b)fluoranthene	ug/kg	600	1100	980	1400 J	790	890	920	620	4500	400 U	*1,310*
Benzo(ghi)perylene	ug/kg	140 J	210 J	370	760 J	220 J	290 J	180 J	150 J	2100	400 U	*687*
Benzo(k)fluoranthene	ug/kg	150 J	220 J	400	850 J	220 J	200 J	220 J	130 J	1600	400 U	*586*
bis(2-Ethylhexyl) phthalate	ug/kg	400 U	450 U	350 U	3700 U	370 U	41 J	410 U	400 U	1600 U	400 U	*1,180*
Chrysene	ug/kg	350 J	540	780	1100 J	440	540	440	360 J	3600	400 U	*794*
Dibenz(a,h)anthracene	ug/kg	400 U	450 U	99 J	3700 U	370 U	84 J	410 U	41 J	640 J	400 U	*580*
Dibenzofuran	ug/kg	86 J	160 J	180 J	3700 U	210 J	240 J	90 J	130 J	430 J	400 U	*260,000*
Diethyl phthalate	ug/kg	400 U	450 U	350 U	3700 U	370 U	370 U	410 U	400 U	1600 U	100 J	*2,400,000*
2,4-Dimethylphenol	ug/kg	400 U	450 U	350 U	3700 U	370 U	57 J	410 U	400 U	1600 U	400 U	*600*
Fluoranthene	ug/kg	640	1100	1500	3700 U	510	720	670	540	3800	100 J	*7,400*
Fluorene	ug/kg	400 U	450 U	50 J	3700 U	370 U	62 J	410 U	400 U	250 J	400 U	*280,000*
Indeno(1,2,3-cd)pyrene	ug/kg	170 J	240 J	320 J	3700 U	200 J	240 J	250 J	140 J	1800	400 U	*671*
2-Methylnaphthalene	ug/kg	290 J	480	740	830 J	600	510	250 J	410	1300 J	400 U	*680*
Naphthalene	ug/kg	180 J	360 J	510	3700 U	360 J	240 J	170 J	330 J	810 J	400 U	*680*
Pentachlorophenol	ug/kg	30 U	34 U	110 U	620	39	11 U	62 U	30 U	370	30 U	*16*
Phenanthrene	ug/kg	350 J	620	850	960 J	540	1600	410	500	1900	87 J	*656*
Pyrene	ug/kg	550	880	1100	1100 J	540	760	630	490	6100	82 J	*220,000*
Pesticides												
Aroclor 1260	ug/kg	200 U	370	180 U	1100 J	370 J	430 J	210 U	200 U	1000 J	400 U	*4.0E-04*
Metals/Inorganics												
Antimony	mg/kg	0.61 UJ	0.77 U*	0.53 UJ	2.6 J	1.7 U*	0.55 UJ	0.69 U*	0.7 U*	0.97 U*	0.61 UJ	*1.1*
Arsenic	mg/kg	5.9	11.6	4.8	101	65.6	9.9	11.1	29.5	17.9	8.8	*12.0*
Barium	mg/kg	55.4	83.5	56.3	120	69.5	61.3	148	62.5	166	71.1	*255.8*
Beryllium	mg/kg	0.61 U	0.68 U	0.53 U	0.57 U	0.57 U	0.55 U	0.62 U	0.61 U	2	0.61 U	*1.5*
Cadmium	mg/kg	0.37	0.63	0.69	2.3	0.82	0.41	1.3	0.36	0.68	0.3	*2.1*
Chromium	mg/kg	4.8	12.5	16.8	33.6	16.1	11.5	13.2	9.7	8.5	26.7	*23.9*
Cobalt	mg/kg	6.1 U	6.8 U	5.3 U	5.7 U	5.7 U	5.5 U	6.2 U	6.1 U	6 U	10.1	*8.9*
Copper	mg/kg	16.7	42.9	15.3	95.3	43.1	15.3	51.9	16.8	21.6	18.9	*46.1*
Lead	mg/kg	23	59.3	49.6	238	121	40.6	104	23.3	61.5	11	*63.3*
Mercury	mg/kg	0.5 J	5.4 J	0.11 U	0.15 J	0.21 J	0.16 J	0.77 J	0.26 J	0.14 J	0.12 U	*0.8*
Nickel	mg/kg	7.6	10.9	8.2	22	12.9	9.5	13.3	13	8.8	25.6	*22.3*
Total Cyanide (2)	mg/kg	0.66	0.34 U	0.27 U	0.043	0.28 U	0.28 U	0.31 U	0.3 U	0.3 U	0.3 U	*0.1*
Vanadium	mg/kg	9.1	13.2	8.1	10	11.6	10.9	12.5	16.3	7.2	29.7	*41.1*
Zinc	mg/kg	87	130	35.2	124	113	65.9	335	69.7	66.2	56	*216.8*

Notes:

- U This compound was not detected at or above the associated numerical value. (Quantitation limit shown.)
- U* This compound should be considered "not detected" since it was detected in a blank at a similar level. (Quantitation limit shown.)
- J Quantitation is approximate due to limitations identified during the quality assurance review (data validation).
- UJ This compound was not detected, but the quantitation limit is probable higher due to a low bias identified during the quality assurance review. (Quantitation limit shown.)

(1) Appropriate Preliminary Site-specific Action Levels (PSALs) for fill were utilized.
(2) Analytical data for total cyanide could only be compared to the more conservative PSAL for amenable cyanide.
Shaded values indicate constituent concentrations which exceed the preliminary site-specific action levels.

TABLE 7-6

80% UCL Concentrations for SWMU G Soil Samples
BASF - Wyandotte RFI

CONSTITUENT	UNITS	80% UCL (1)	PRELIMINARY SITE-SPECIFIC ACTION LEVEL (PSAL) (2)	80% UCL EXCEED PSAL?
Semi-Volatile Organics				
Acenaphthene	ug/kg	549	470	**YES**
Acenaphthylene	ug/kg	463	470	NO
Anthracene	ug/kg	506	2,200,000	NO
Benzo(a)anthracene	ug/kg	1,044	972	**YES**
Benzo(a)pyrene	ug/kg	1,091	881	**YES**
Benzo(b)fluoranthene	ug/kg	1,536	1,310	**YES**
Benzo(ghi)perylene	ug/kg	631	687	NO
Benzo(k)fluoranthene	ug/kg	549	586	NO
bis(2-Ethylhexyl) phthalate	ug/kg	560	1,180	NO
Chrysene	ug/kg	1,115	794	**YES**
Dibenz(a,h)anthracene	ug/kg	525	580	NO
Dibenzofuran	ug/kg	507	260,000	NO
Diethyl phthalate	ug/kg	564	2,400,000	NO
2,4-Dimethylphenol	ug/kg	562	600	NO
Fluoranthene	ug/kg	1,440	7,400	NO
Fluorene	ug/kg	492	280,000	NO
Indeno(1,2,3-cd)pyrene	ug/kg	730	671	**YES**
2-Methylnaphthalene	ug/kg	653	680	NO
Naphthalene	ug/kg	644	680	NO
Pentachlorophenol	ug/kg	176	16	**YES**
Phenanthrene	ug/kg	941	656	**YES**
Pyrene	ug/kg	1,709	220,000	NO
Pesticides				
Aroclor 1260	ug/kg	491	4.0E-04	**YES**
Metals/Inorganics				
Antimony	mg/kg	0.8	1.1	NO
Arsenic	mg/kg	35.5	12.0	**YES**
Barium	mg/kg	100.7	255.8	NO
Beryllium	mg/kg	0.6	1.5	NO
Cadmium	mg/kg	1.0	2.1	NO
Chromium	mg/kg	17.8	23.9	NO
Cobalt	mg/kg	4.3	8.9	NO
Copper	mg/kg	40.9	46.1	NO
Lead	mg/kg	92.0	63.3	**YES**
Mercury	mg/kg	1.2	0.8	**YES**
Nickel	mg/kg	14.9	22.3	NO
Total Cyanide (3)	mg/kg	0.2	0.1	**YES**
Vanadium	mg/kg	14.7	41.1	NO
Zinc	mg/kg	132.1	216.8	NO

(1) 80% UCL = Mean + 0.883(Standard Deviation/n^0.5), where n=10
(2) Appropriate Preliminary Site-specific Action Levels (PSALs) for fill were utilized.
(3) Analytical data for total cyanide could only be compared to the more conservative PSAL for amenable cyanide.

TABLE 7-7

Detected Constituent Concentrations for SWMU H Soil Samples
BASF - Wyandotte RFI

CONSTITUENT	UNITS	SAMPLE ID NUMBERS AND RESULTS										PRELIMINARY SITE-SPECIFIC ACTION LEVEL (PSAL) (1)
		SG006SWMUHSP01A	SG014SWMUHSP02C	SG018SWMUHSP03A	SG022SWMUHSP04AII	SG017SWMUHSP05C	SG017SWMUHSP06E	SG010SWMUHSP07A	SG009SWMUHSP08B	SG015SWMUHSP09A	SG015SWMUHSP10A	
Volatile Organics												
Acetone	ug/kg	20 J	130 J	52000 U	31 J	340	310 J	81	17000 U	7800000 U	1600 J	500,000
Benzene	ug/kg	7.4 UJ	7.5 UJ	5200 U	6.3 UJ	16 U	18 UJ	6.2 U	4300 U	1900000 U	780 J	1,060
Chlorobenzene	ug/kg	7.4 UJ	7.5 UJ	5200 U	6.3 UJ	16 U	18 UJ	6.2 U	4300 U	1900000 U	830 J	520
1,2-Dichlorobenzene	ug/kg	7.4 UJ	7.5 UJ	5200 U	6.3 UJ	16 U	18 UJ	6.2 U	4300 U	1900000 U	680 J	140
1,2-Dichloropropane	ug/kg	4 J	7.5 UJ	140000	6.3 UJ	7.7 J	26 J	13	130000	50000000	13000	1,280
Ethylbenzene	ug/kg	7.4 UJ	7.5 UJ	5200 U	6.3 UJ	16 U	18 UJ	6.2 U	4300 U	1900000 U	470 J	620
Methyl ethyl ketone	ug/kg	74 UJ	31 J	52000 U	63 UJ	160 U	180 UJ	62 U	17000 U	7800000 U	4400 U	144,000
m-Xylene & p-Xylene	ug/kg	7.4 U	7.5 U	5200 U	6.3 UJ	16 U	18 U	6.2 U	4400 U	970000 U	1500	1,180
o-Xylene	ug/kg	7.4 UJ	7.5 UJ	5200 U	6.3 UJ	16 U	18 UJ	6.2 U	2200 U	970000 U	570	1,180
Toluene	ug/kg	7.4 UJ	7.5 UJ	5200 U	6.3 UJ	16 U	13 J	6.2 U	4300 U	1900000 U	5800	2,200
1,2,3-Trichloropropane	ug/kg	7.4 UJ	7.5 UJ	3900 J	6.3 UJ	16 U	18 UJ	6.2 U	17000	1900000 U	1100 U	6.6
Semi-Volatile Organics												
Acenaphthene	ug/kg	490 U	490 U	1900	420 U	430 U	470 U	410 U	5800 U	210000 U	6700 J	470
Anthracene	ug/kg	74 J	490 U	550 U	420 U	430 U	470 U	410 U	5800 U	210000 U	5300 J	2,200,000
Benzo(a)anthracene	ug/kg	250 J	490 U	550 U	420 U	430 U	470 U	410 U	5800 U	210000 U	4500 J	972
Benzo(a)pyrene	ug/kg	210 J	490 U	550 U	420 U	430 U	470 U	410 U	5800 U	210000 U	3100 J	881
Benzo(b)fluoranthene	ug/kg	380 J	490 U	550 U	420 U	430 U	470 U	410 U	5800 U	210000 U	4200 J	1,310
Benzo(ghi)perylene	ug/kg	180 J	490 U	550 U	420 U	430 U	470 U	410 U	5800 U	210000 U	19000 U	687
Benzo(k)fluoranthene	ug/kg	130 J	490 U	550 U	420 U	430 U	470 U	410 U	5800 U	210000 U	19000 U	586
bis(2-Chloroethyl) ether	ug/kg	490 U	490 U	550 U	420 U	430 U	470 U	410 U	5800 U	210000 U	12000 J	118
bis(2-Chloroisopropyl) ether	ug/kg	170 J	490 U	1800	420 U	430 U	130 J	1200	30000	1400000	130000	6,700
bis(2-Ethylhexyl) phthalate	ug/kg	1900	490 U	550 U	420 U	430 U*	470 U	410 U	5800 U	210000 U	10000 J	1,180
4-Chloro-3-methylphenol	ug/kg	490 U	490 U	3200	420 U	430 U	470 U	410 U	5800 U	210000 U	19000 U	88
2-Chlorophenol	ug/kg	490 U	490 U	3000	420 U	430 U	470 U	410 U	5800 U	210000 U	19000 U	200
Chrysene	ug/kg	280 J	490 U	550 U	420 U	430 U	470 U	410 U	5800 U	210000 U	4800 J	794
Dibenzofuran	ug/kg	490 U	490 U	550 U	420 U	430 U	470 U	410 U	5800 U	210000 U	4200 J	260,000
2,4-Dimethylphenol	ug/kg	490 U	490 U	550 U	420 U	430 U	470 U	410 U	5800 U	210000 U	8300 J	600
2,4-Dinitrotoluene	ug/kg	490 U	490 U	2400	420 U	430 U	470 U	410 U	5800 U	210000 U	19000 U	1,820
Fluoranthene	ug/kg	270 J	490 U	550 U	420 U	430 U	470 U	410 U	5800 U	210000 U	11000 J	7,400
Fluorene	ug/kg	490 U	490 U	550 U	420 U	430 U	470 U	410 U	5800 U	210000 U	5400 J	280,000
Indeno(1,2,3-cd)pyrene	ug/kg	150 J	490 U	550 U	420 U	430 U	470 U	410 U	5800 U	210000 U	19000 U	671
2-Methylnaphthalene	ug/kg	120 J	490 U	550 U	420 U	430 U	470 U	410 U	5800 U	210000 U	6400 J	680
3-Methylphenol	ug/kg	490 U	490 U	550 U	420 U	430 U	470 U	410 U	5800 U	210000 U	4500 JN	2,000,000
4-Methylphenol	ug/kg	490 U	490 U	550 U	420 U	430 U	470 U	410 U	5800 U	210000 U	4900 JN	124
Naphthalene	ug/kg	93 J	490 U	550 U	420 U	430 U	470 U	410 U	5800 U	210000 U	16000 J	680
4-Nitrophenol	ug/kg	2400 U	2400 U	4500	2000 U	2100 U	2300 U	2000 U	28000 U	1000000 U	95000 U	84,000
N-Nitrosodi-n-propylamine	ug/kg	490 U	490 U	1900	420 U	430 U	470 U	410 U	5800 U	210000 U	19000 U	0.05
Pentachlorophenol	ug/kg	46	15 UJ	17 U	6.3 U	13 U	7.2 U	10 J	35 U	170 J	300 J	16
Phenanthrene	ug/kg	300 J	490 U	550 U	420 U	430 U	470 U	410 U	5800 U	210000 U	20000	656
Phenol	ug/kg	270 J	490 U	2800	420 U	430 U	470 U	410 U	5800 U	210000 U	19000 U	22,000
Pyrene	ug/kg	330 J	490 U	2200	420 U	430 U	470 U	410 U	5800 U	210000 U	8600 J	220,000
1,2,4-Trichlorobenzene	ug/kg	490 U	490 U	1900	420 U	430 U	470 U	410 U	5800 U	210000 U	19000 U	440
Pesticides												
alpha-Chlordane	ug/kg	12 U	12 U	2.8 U	4.3 U	2.2 U	2.4 U	2.1 U	2.4 U	13 U	40 JN	1.1E-02
Aroclor 1248	ug/kg	120 U	120 U	55 U	420 U	43 U	470 U	410 U	460 U	510 U	1600	4.0E-04
Aroclor 1254	ug/kg	250 U	250 U	55 U	420 U	43 U	470 U	410 U	460 U	510 U	1200 J	4.0E-04
Herbicides												
2,4-D	ug/kg	150 U	150 UJ	280	130 U	130 U	140 U	120 U	140 U	420	180 U	940
2,4,5-T	ug/kg	37 U	37 UJ	240	32 U	33 U	36 U	31 U	35 U	350	44 U	650,000
2,4,5-TP (Silvex)	ug/kg	37 U	37 UJ	100	32 U	33 U	36 U	31 U	35 U	200	44 U	420
Metals/Inorganics												
Antimony	mg/kg	52.2	0.75 UJ	0.83 UJ	0.63 UJ	0.66 UJ	0.72 UJ	0.62 UJ	0.7 UJ	45.9	15.3 J	1.1
Arsenic	mg/kg	331	3.2	7.9 J	4.8	4.4 J	5	1.9	3	329	116	12.0
Barium	mg/kg	335	116	66.4	94.4	73.8	78.4	8	78.2	344	223	255.8
Beryllium	mg/kg	7.4	0.91	0.83 U	0.63 U	0.66 U	0.72 U	0.62 U	0.7 U	7.6	0.89 U	1.5
Cadmium	mg/kg	8.4	0.26	0.48	0.5	0.69	0.32	0.12 U	0.47	8	4.2	2.1
Chromium	mg/kg	62.2	36.9 J	25 J	26.7	21.2 J	22.3 J	6.7	24.9	50.4	195	23.9
Cobalt	mg/kg	72	13.7	11.4	10.9	9.6	10.2	6.2 U	7 U	75.3	10.3	8.9
Copper	mg/kg	79.1	20.7	22.9	20.6	23.8	15.2	2.9	18.6	77.3	221	46.1
Lead	mg/kg	125	11.9	11	9.2	10.6	9.8	2.7	9.2	119	433	63.3
Mercury	mg/kg	1.8	0.15 U	0.17 U	0.13 U	0.14	0.14 U	0.12 U	0.14 U	1.6	52.8	0.8
Nickel	mg/kg	92.1	36.5	29.9	27.7 J	22.6	24.4	5.7	13.8	103	93.4	22.3
Selenium	mg/kg	282	0.75 UJ	0.83 UJ	0.63 U	0.66 UJ	0.72 UJ	0.62 U	0.7 U	295	1.4 J	3.5
Silver	mg/kg	7.4	1.5 UJ	1.7 UJ	1.3 U	1.3 UJ	1.4 UJ	1.2 U	1.4 U	8.6	21.7	3.0
Thallium	mg/kg	266	1.5 U	1.7 U	1.3 U	1.3 U	1.4 U	1.2 U	1.4 U	282	1.8 U	3.0
Tin	mg/kg	263	150 U	165 U	126 U	132 U	143 U	125 U	140 U	278	177 U	46,000.0
Total Cyanide (2)	mg/kg	1.3 J	0.6 J	0.41 UJ	0.32 UJ	0.33 UJ	0.36 UJ	0.019	0.35 UJ	6.6 J	16 J	0.1
Vanadium	mg/kg	84.3	50.9	30.9	41.5	24.3	33.9	8.7	36.7	87.5	24	41.1
Zinc	mg/kg	171	69.3 J	60 J	62.2 J	46.5 J	39.4 J	13.2 J	45.3 J	298	828 J	216.8

Notes:

U This compound was not detected at or above the associated numerical value. (Quantitation limit shown.)
U* This compound should be considered "not detected" since it was detected in a blank at a similar level. (Quantitation limit shown.)
J Quantitation is approximate due to limitations identified during the quality assurance review (data validation).
UJ This compound was not detected, but the quantitation limit is probable higher due to a low bias identified during the quality assurance review. (Quantitation limit shown.)
N This result should be considered a tentative qualitative identification.

(1) Appropriate Preliminary Site-specific Action Levels (PSALs) for fill were utilized.
(2) Analytical data for total cyanide could only be compared to the more conservative PSAL for amenable cyanide.
Shaded values indicate constituent concentrations which exceed the preliminary site-specific action levels.

TABLE 7-8

80% UCL Concentrations for SWMU H Soil Samples
BASF - Wyandotte RFI

CONSTITUENT	UNITS	80% UCL (1)	PRELIMINARY SITE-SPECIFIC ACTION LEVEL (PSAL) (2)	80% UCL EXCEED PSAL?
Volatile Organics				
Acetone	ug/kg	737,716	500,000	YES
Benzene	ug/kg	179,387	1,060	YES
Chlorobenzene	ug/kg	179,391	520	YES
1,2-Dichlorobenzene	ug/kg	179,378	140	YES
1,2-Dichloropropane	ug/kg	9,440,556	1,280	YES
Ethylbenzene	ug/kg	179,359	620	YES
Methyl ethyl ketone	ug/kg	737,715	144,000	YES
m-Xylene & p-Xylene	ug/kg	91,897	1,180	YES
o-Xylene	ug/kg	91,714	1,180	YES
Toluene	ug/kg	179,841	2,200	YES
1,2,3-Trichloropropane	ug/kg	180,835	6.6	YES
Semi-Volatile Organics				
Acenaphthene	ug/kg	20,949	470	YES
Anthracene	ug/kg	20,655	2,200,000	NO
Benzo(a)anthracene	ug/kg	20,596	972	YES
Benzo(a)pyrene	ug/kg	20,462	881	YES
Benzo(b)fluoranthene	ug/kg	20,579	1,310	YES
Benzo(ghi)perylene	ug/kg	21,068	687	YES
Benzo(k)fluoranthene	ug/kg	21,063	586	YES
bis(2-Chloroethyl) ether	ug/kg	21,320	118	YES
bis(2-Chloroisopropyl) ether	ug/kg	278,933	6,700	YES
bis(2-Ethylhexyl) phthalate	ug/kg	21,271	1,180	YES
4-Chloro-3-methylphenol	ug/kg	21,337	88	YES
2-Chlorophenol	ug/kg	21,319	200	YES
Chrysene	ug/kg	20,627	794	YES
Dibenzofuran	ug/kg	20,567	260,000	NO
2,4-Dimethylphenol	ug/kg	20,957	600	YES
2,4-Dinitrotoluene	ug/kg	21,264	1,820	YES
Fluoranthene	ug/kg	21,223	7,400	YES
Fluorene	ug/kg	20,680	280,000	NO
Indeno(1,2,3-cd)pyrene	ug/kg	21,065	671	YES
2-Methylnaphthalene	ug/kg	20,763	680	YES
3-Methylphenol	ug/kg	20,595	2,000,000	NO
4-Methylphenol	ug/kg	20,633	124	YES
Naphthalene	ug/kg	21,713	680	YES
4-Nitrophenol	ug/kg	100,886	84,000	YES
N-Nitrosodi-n-propylamine	ug/kg	21,219	0.05	YES
Pentachlorophenol	ug/kg	85	16	YES
Phenanthrene	ug/kg	22,151	656	YES
Phenol	ug/kg	21,303	22,000	NO
Pyrene	ug/kg	21,166	220,000	NO
1,2,4-Trichlorobenzene	ug/kg	21,219	440	YES
Pesticides				
alpha-Chlordane	ug/kg	10	1.1E-02	YES
Aroclor 1248	ug/kg	422	4.0E-04	YES
Aroclor 1254	ug/kg	358	4.0E-04	YES
Herbicides				
2,4-D	ug/kg	161	940	NO
2,4,5-T	ug/kg	107	650,000	NO
2,4,5-TP (Silvex)	ug/kg	61	420	NO
Metals/Inorganics				
Antimony	mg/kg	17.3	1.1	YES
Arsenic	mg/kg	118.6	12.0	YES
Barium	mg/kg	174.5	255.8	NO
Beryllium	mg/kg	2.7	1.5	YES
Cadmium	mg/kg	3.3	2.1	YES
Chromium	mg/kg	62.3	23.9	YES
Cobalt	mg/kg	29.7	8.9	YES
Copper	mg/kg	68.4	46.1	YES
Lead	mg/kg	111.7	63.3	YES
Mercury	mg/kg	10.3	0.8	YES
Nickel	mg/kg	55.1	22.3	YES
Selenium	mg/kg	92.0	3.5	YES
Silver	mg/kg	6.2	3.0	YES
Thallium	mg/kg	87.6	3.0	YES
Tin	mg/kg	135.5	46,000.0	NO
Total Cyanide (3)	mg/kg	4.0	0.1	YES
Vanadium	mg/kg	49.4	41.1	YES
Zinc	mg/kg	196.4	216.8	NO

(1) 80% UCL = Mean + 0.883(Standard Deviation/n^0.5), where n=10
(2) Appropriate Preliminary Site-specific Action Levels (PSALs) for fill were utilized.
(3) Analytical data for total cyanide could only be compared to the more conservative PSAL for amenable cyanide.

TABLE 7-9

Detected Constituent Concentrations for AOC 2 Soil Samples
BASF - Wyandotte RFI

CONSTITUENT	UNITS	SAMPLE ID NUMBERS AND RESULTS								PRELIMINARY SITE-SPECIFIC ACTION LEVEL (PSAL) (1)
		SG003AOC2-1	SG003AOC2-2	SG008AOC2-3	SG002AOC2-4	SG002AOC2-5	SG001AOC2-6	SG005AOC2-7 (MS/MSD)	SG001AOC2-8	
Volatile Organics										
Acetone	ug/kg	61 UJ	52 UJ	60 UJ	66 UJ	58 U	60 U	100 J	68 U	*500,000*
Benzene	ug/kg	6.1 U	5.2 U	6 UJ	6.6 U	5.8 U	6 U	27	6.8 U	*1,060*
Ethylbenzene	ug/kg	6.1 U	5.2 U	6 UJ	6.6 U	5.8 U	6 U	4.9 J	6.8 U	*620*
Methylene chloride	ug/kg	6.1 U*	5.2 U*	6 U*	6.6 U*	5.8 U	6 U	27	6.8 U	*1,180*
Toluene	ug/kg	6.1 U	5.2 U	6 UJ	6.6 U	5.8 U	13	43	6.8 U	*2,200*
m-Xylene & p-Xylene	ug/kg	6.1 U	5.2 U	6 UJ	6.6 U	5.8 U	6 U	25	6.8 U	*1,180*
o-Xylene	ug/kg	6.1 U	5.2 U	6 UJ	6.6 U	5.8 U	6 U	6.1 J	6.8 U	*1,180*
Semi-Volatile Organics										
Acenaphthylene	ug/kg	190 J	340 U	160 J	430 U	380 U	82 J	410 U	450 U	*470*
Acetophenone	ug/kg	800 U	340 U	290 J	430 U	380 U	390 U	180 J	450 U	*5,600,000*
Anthracene	ug/kg	590 J	52 J	88 J	430 U	380 U	80 J	230 J	450 U	*2,200,000*
Benzo(a)anthracene	ug/kg	2000	58 J	510 J	430 U	380 U	590	290 J	120 J	*972*
Benzo(b)fluoranthene	ug/kg	2200	340 U	640 J	430 U	380 U	560	310 J	96 J	*1,310*
Benzo(ghi)perylene	ug/kg	620 J	340 U	280 J	430 U	380 U	280 J	130 J	61 J	*687*
Benzo(a)pyrene	ug/kg	1700	340 U	520 J	430 U	380 U	450	170 J	85 J	*881*
Benzo(k)fluoranthene	ug/kg	980	340 U	250 J	430 U	380 U	270 J	120 J	450 U	*586*
bis(2-Ethylhexyl) phthalate	ug/kg	800 U	99 J	800 U	430 U	380 U	270 J	89 J	110 J	*1,180*
Chrysene	ug/kg	1700	57 J	550 J	430 U	380 U	420	270 J	98 J	*794*
Dibenz(a,h)anthracene	ug/kg	190 J	340 U	800 U	430 U	380 U	72 J	410 U	450 U	*580*
Dibenzofuran	ug/kg	240 J	340 U	780 J	430 U	380 U	130 J	140 J	450 U	*260,000*
Fluoranthene	ug/kg	2700	90 J	690 J	430 U	380 U	640	730	200 J	*7,400*
Indeno(1,2,3-cd)pyrene	ug/kg	700 J	340 U	240 J	430 U	380 U	250 J	130 J	70 J	*671*
2-Methylnaphthalene	ug/kg	820	340 U	3400	430 U	380 U	290 J	310 J	450 U	*680*
Naphthalene	ug/kg	580 J	340 U	2500	430 U	380 U	680	1000	450 U	*680*
Phenanthrene	ug/kg	1200	97 J	1200	430 U	380 U	340 J	760	120 J	*656*
Pyrene	ug/kg	2600	87 J	810	430 U	380 U	610	500	170 J	*220,000*
Metals/Inorganics										
Arsenic	mg/kg	34	0.73	19.8	12.1	4.7	41	19.8	12.4	*12.0*
Barium	mg/kg	34	4.5	48.5	29.3	78.9	59.4	48.9	39.9	*255.8*
Cadmium	mg/kg	0.25	0.14	0.32	3.5	0.21	0.8 J	0.2	0.28	*2.1*
Chromium	mg/kg	9.1	5.3	8.7	6	101	10.4 J	5.9	52.5	*23.9*
Copper	mg/kg	16.7	3.2	24.4	14.6	15.1 J	20 J	9.6 J	16.9 J	*46.1*
Lead	mg/kg	22.3	2.4	31.8	9.2	3.9	78.1	10	8.3	*63.3*
Mercury	mg/kg	1.2 J	0.1 U	0.28 J	0.13 U	17.1	0.28	0.15	0.14 U	*0.8*
Nickel	mg/kg	11.5	4.8	13.3	10.2	11.8 J	8.9 J	7.4 J	10.4 J	*22.3*
Selenium	mg/kg	0.61 U	0.52 U	0.76	0.66 U	0.58 U	0.6 U	0.62 U	0.68 U	*3.5*
Total Cyanide (2)	mg/kg	0.3 U	0.26 U	1.1	4.7	21	1	46	9.5	*0.1*
Vanadium	mg/kg	14.6	5.2 U	15.7	10.2	18.6	14.8 J	10.4	13.5	*41.1*
Zinc	mg/kg	31.9	18.5	34.9	966	55.4 J	124 J	96.6 J	86.9 J	*216.8*

Notes:

U This compound was not detected at or above the associated numerical value. (Quantitation limit shown.)
U* This compound should be considered "not detected" since it was detected in a blank at a similar level. (Quantitation limit shown.)
J Quantitation is approximate due to limitations identified during the quality assurance review (data validation).
UJ This compound was not detected, but the quantitation limit is probably higher due to a low bias identified during the quality assurance review. (Quantitation limit shown.)
N This result should be considered a tentative qualitative identification.

(1) Appropriate Preliminary Site-specific Action Levels (PSALs) for fill were utilized.
(2) Analytical data for total cyanide could only be compared to the more conservative PSAL for amenable cyanide.
Shaded values indicate constituent concentrations which exceed the preliminary site-specific action levels.

TABLE 7-10

80% UCL Concentrations for AOC 2 Soil Samples
BASF - Wyandotte RFI

CONSTITUENT	UNITS	80% UCL (1)	PRELIMINARY SITE-SPECIFIC ACTION LEVEL (PSAL) (2)	80% UCL EXCEED PSAL?
Volatile Organics				
Acetone	ug/kg	47	500,000	NO
Benzene	ug/kg	9	1,060	NO
Ethylbenzene	ug/kg	3	620	NO
Methylene chloride	ug/kg	9	1,180	NO
Toluene	ug/kg	14	2,200	NO
m-Xylene & p-Xylene	ug/kg	8	1,180	NO
o-Xylene	ug/kg	4	1,180	NO
Semi-Volatile Organics				
Acenaphthylene	ug/kg	194	470	NO
Acetophenone	ug/kg	258	5,600,000	NO
Anthracene	ug/kg	263	2,200,000	NO
Benzo(a)anthracene	ug/kg	698	972	NO
Benzo(b)fluoranthene	ug/kg	768	1,310	NO
Benzo(ghi)perylene	ug/kg	297	687	NO
Benzo(a)pyrene	ug/kg	606	881	NO
Benzo(k)fluoranthene	ug/kg	390	586	NO
bis(2-Ethylhexyl) phthalate	ug/kg	262	1,180	NO
Chrysene	ug/kg	607	794	NO
Dibenz(a,h)anthracene	ug/kg	237	580	NO
Dibenzofuran	ug/kg	329	260,000	NO
Fluoranthene	ug/kg	953	7,400	NO
Indeno(1,2,3-cd)pyrene	ug/kg	307	671	NO
2-Methylnaphthalene	ug/kg	1,054	680	**YES**
Naphthalene	ug/kg	945	680	**YES**
Phenanthrene	ug/kg	665	656	**YES**
Pyrene	ug/kg	910	220,000	NO
Metals/Inorganics				
Arsenic	mg/kg	22.4	12.0	**YES**
Barium	mg/kg	49.9	255.8	NO
Cadmium	mg/kg	1.1	2.1	NO
Chromium	mg/kg	35.8	23.9	**YES**
Copper	mg/kg	17.1	46.1	NO
Lead	mg/kg	28.7	63.3	NO
Mercury	mg/kg	4.3	0.8	**YES**
Nickel	mg/kg	10.6	22.3	NO
Selenium	mg/kg	0.4	3.5	NO
Total Cyanide (3)	mg/kg	15.5	0.1	**YES**
Vanadium	mg/kg	14.1	41.1	NO
Zinc	mg/kg	278.4	216.8	**YES**

(1) 80% UCL = Mean + 0.896(Standard Deviation/n^0.5), where n=8
(2) Appropriate Preliminary Site-specific Action Levels (PSALs) for fill were utilized.
(3) Analytical data for total cyanide could only be compared to the more conservative PSAL for amenable cyanide.

TABLE 7-11

Constituent Concentrations for AOC 4 Tar Samples
BASF - Wyandotte RFI

CONSTITUENT	UNITS	SAMPLE ID NUMBERS AND RESULTS SG-003-AOC4-1	SG-001-AOC4-2	PRELIMINARY SITE-SPECIFIC ACTION LEVEL (PSAL) (1)
Volatile Organics				
Benzene	ug/kg	680,000	250,000	*1,060*
Styrene	ug/kg	240,000 J	96,000 J	*380*
Toluene	ug/kg	590,000	190,000	*2,200*
m-Xylene & p-Xylene	ug/kg	740,000	170,000	*1,180*
o-Xylene	ug/kg	240,000 J	170,000 U	*1,180*
Semi-Volatile Organics				
Acenaphthylene	ug/kg	9,300,000	1,000,000 J	*470*
Anthracene	ug/kg	7,100,000 J	870,000 J	*2,200,000* → 41,000
Benzo(a)anthracene	ug/kg	4,900,000 J	490,000 J	*972*
Benzo(b)fluoranthene	ug/kg	4,400,000 J	410,000 J	*1,310*
Benzo(k)fluoranthene	ug/kg	2,500,000 J	190,000 J	*586*
Benzo(ghi)perylene	ug/kg	1,500,000 J	1,100,000 U	*687*
Benzo(a)pyrene	ug/kg	4,100,000 J	330,000 J	*881*
Chrysene	ug/kg	5,200,000 J	470,000 J	*794*
Dibenzofuran	ug/kg	5,900,000 J	740,000 J	*260,000* 1700
Fluoranthene	ug/kg	14,000,000	1,600,000	*7,400* 5300
Fluorene	ug/kg	9,500,000	1,200,000	*280,000* 5300
Indeno(1,2,3-cd)pyrene	ug/kg	1,600,000 J	120,000 J	*671*
2-Methylnaphthalene	ug/kg	9,000,000	940,000 J	*680*
3-Methylphenol	ug/kg	2,700,000 JN	230,000 JN	*2,000,000*
4-Methylphenol	ug/kg	2,700,000 JN	230,000 JN	*124*
Naphthalene	ug/kg	48,000,000	6,000,000	*680*
Phenanthrene	ug/kg	23,000,000	2,700,000	*656*
Phenol	ug/kg	2,300,000 J	1,100,000 U	*22,000*
Pyrene	ug/kg	9,900,000	1,100,000	*220,000*
Metals/Inorganics				
Arsenic	mg/kg	20.5	14.5	*12.0*
Barium	mg/kg	12.5	33.5	*255.8*
Cadmium	mg/kg	1.4	1.4	*2.1*
Chromium	mg/kg	0.73	1.2	*23.9*
Copper	mg/kg	3.7	3.4	*46.1*
Lead	mg/kg	82.8	49	*63.3*
Mercury	mg/kg	0.62 J	0.13 J	*0.8*
Selenium	mg/kg	3.6	2.6	*3.5*
Thallium	mg/kg	14	7.2	*3.0*
Total Cyanide (2)	mg/kg	11	19	*0.1*
Zinc	mg/kg	101	114	*216.8*

Notes:

U This compound was not detected at or above the associated numerical value. (Quantitation limit shown.)
J Quantitation is approximate due to limitations identified during the quality assurance review (data validation).
JN Quantitation is approximate due to limitations identified during the quality assurance review (data validation). This result should be considered a tentative qualitative identification.

(1) Appropriate Preliminary Site-specific Action Levels (PSALs) for fill were utilized.
(2) Analytical data for total cyanide could only be compared to the more conservative PSAL for amenable cyanide.
Shaded values indicate constituent concentrations which exceed the preliminary site-specific action levels.

TABLE 7-12

Detected Constituent Concentrations for AOC 5 Soil Samples
BASF - Wyandotte RFI

CONSTITUENT	UNITS	SAMPLE ID NUMBERS AND RESULTS: SG004RFIMW07	SG007RFIMW07	SG010RFIMW07	SG013RFIMW07	SG016RFIMW07	SG019RFIMW07	SG004RFIMW08	SG007RFIMW08	SG010RFIMW08	SG013RFIMW08	SG016RFIMW08	SG019RFIMW08	SG022RFIMW08 (MS/MSD)	SG027RFIMW08	SG030RFIMW08	SG033RFIMW08	PRELIMINARY SITE-SPECIFIC ACTION LEVEL (PSAL)
Volatile Organics																		
Acetone	ug/kg	58 U	43 J	160 J	57 J	150 J	36 J	52 J	45 J	41 J	41 J	51 J	40 J	28 J	13 J	36 J	15 J	500,000
Carbon disulfide	ug/kg	5.8 U	11 U	58 U	16 U	12 U	9.2 U	5.9 U	11 U	3.3 J	7.5 U	7.2 U	6.7 U	6.3 U	6.1 U	6.2 U	5.6 U	32,000
1,1-Dichloroethane	ug/kg	5.8 U	11 U	58 U	12 J	12 U	9.2 U	5.9 U	11 U	8.3 U	7.5 U	7.2 U	6.7 U	6.3 U	6.1 U	6.2 U	5.6 U	23,000
Ethylbenzene	ug/kg	5.8 U	11 U	26 J	21	12 U	9.2 U	5.9 U	11 U	8.3 U	7.5 U	7.2 U	6.7 UJ	6.3 U	6.1 U	6.2 U	5.6 UJ	620
Methyl ethyl ketone	ug/kg	58 U	110 U	580 U	28 J	34 J	92 U	7.7 J	110 U	83 U	12 J	15 J	13 J	63 U	61 U	16 J	56 U	144,000
m-Xylene & p-Xylene	ug/kg	5.8 U	11 U	70	33	12 U	9.2 U	5.9 U	11 U	8.3 U	7.5 U	7.2 U	6.7 UJ	6.3 U	6.1 U	6.2 U	5.6 UJ	1,180
o-Xylene	ug/kg	5.8 U	11 U	28 J	13 J	12 U	9.2 U	5.9 U	11 U	8.3 U	7.5 U	7.2 U	6.7 UJ	6.3 U	6.1 U	6.2 U	5.6 UJ	1,180
Toluene	ug/kg	2.6	11 U	58 U	16 U	12 U	9.2 U	2.9 J	11 U	8.3 U	7.5 U	7.2 U	6.7 UJ	6.3 U	6.1 U	6.2 U	5.6 UJ	2,200
1,1,1-Trichloroethane	ug/kg	3.2	11 U	58 U	37	12 U	9.2 U	5.9 U	11 U	8.3 U	7.5 U	7.2 U	6.7 U	6.3 U	6.1 U	6.2 U	5.6 U	2,400
Semi-Volatile Organics																		
Acenaphthene	ug/kg	390 U	710 U	370 J	1100 U	1600 U	610 U	390 U	720 U	550 U	500 U	480 U	440 U	420 U	400 U	410 U	370 U	470
Anthracene	ug/kg	390 U	710 U	760 U	1100 U	1600 U	610 U	290 J	720 U	300 J	500 U	480 U	440 U	420 U	400 U	410 U	370 U	2,200,000
Benzo(a)anthracene	ug/kg	390 U	710 U	760 U	1100 U	1600 U	610 U	830	720 U	550	500 U	480 U	440 U	420 U	400 U	410 U	370 U	972
Benzo(b)fluoranthene	ug/kg	220 J	710 U	760 U	1100 U	1600 U	610 U	870	720 U	530 J	500 U	480 U	440 U	420 U	400 U	410 U	370 U	1,310
Benzo(k)fluoranthene	ug/kg	390 U	710 U	760 U	1100 U	1600 U	610 U	290 J	720 U	550 U	500 U	480 U	440 U	420 U	400 U	410 U	370 U	586
Benzo(ghi)perylene	ug/kg	390 U	710 U	760 U	1100 U	1600 U	610 U	230 J	720 U	550 U	500 U	480 U	440 U	420 U	400 U	410 U	370 U	687
Benzo(a)pyrene	ug/kg	390 U	710 U	760 U	1100 U	1600 U	200 J	580	720 U	500 J	500 U	480 U	440 U	420 U	400 U	410 U	370 U	881
bis(2-Ethylhexyl) phthalate	ug/kg	390 U	300 J	760 U	1100 U	1600 U	610 U	220 J	720 U	550 U	150 J	480 U	130 J	420 U	400 U	410 U	370 U	1,180
Chrysene	ug/kg	390 U	710 U	760 U	1100 U	1600 U	610 U	680	720 U	510 J	500 U	480 U	440 U	420 U	400 U	410 U	370 U	794
Dibenzofuran	ug/kg	160 J	710 U	760 U	1100 U	1600 U	610 U	390 U	720 U	550 U	500 U	480 U	440 U	420 U	400 U	410 U	370 U	260,000
2,4-Dimethylphenol	ug/kg	390 U	710 U	760 U	1100 U	1600 U	170 J	390 U	720 U	550 U	500 U	480 U	440 U	420 U	400 U	410 U	370 U	600
Di-n-octyl phthalate	ug/kg	390 U	710 U	760 U	1100 U	1600 U	610 U	260 J	720 U	550 U	500 U	480 U	440 U	420 U	400 U	410 U	370 U	10,000,000
Fluoranthene	ug/kg	390 U	710 U	760 U	1100 U	1600 U	610 U	1700	260 J	750	500 U	480 U	440 U	420 U	400 U	410 U	370 U	7,400
Fluorene	ug/kg	390 U	710 U	760 U	1100 U	1600 U	610 U	150 J	720 U	550 U	500 U	480 U	440 U	420 U	400 U	410 U	370 U	280,000
Indeno(1,2,3-cd)pyrene	ug/kg	390 U	710 U	760 U	1100 U	1600 U	610 U	280 J	720 U	550 U	500 U	480 U	440 U	420 U	400 U	410 U	370 U	671
2-Methylnaphthalene	ug/kg	480	710 U	5500 J	690 J	1600 U	610 U	390 U	720 U	550 U	500 U	480 U	440 U	420 U	400 U	410 U	370 U	680
3-Methylphenol	ug/kg	390 U	710 U	760 U	1100 U	1400 J	1300	390 U	720 U	550 U	500 U	480 U	440 U	420 U	400 U	410 U	370 U	2,000,000
4-Methylphenol	ug/kg	390 U	710 U	760 U	1100 U	2100	1600	390 U	720 U	550 U	500 U	480 U	440 U	420 U	400 U	410 U	370 U	124
Naphthalene	ug/kg	230 J	710 U	580 J	1100 U	1600 U	610 U	390 U	720 U	550 U	500 U	480 U	440 U	420 U	400 U	410 U	370 U	680
Phenanthrene	ug/kg	440	710 U	1100 J	1100 U	1600 U	610 U	1300	610 J	780	500 U	480 U	440 U	420 U	400 U	410 U	370 U	656
Phenol	ug/kg	390 U	710 U	760 U	1100 U	11000	740	390 U	720 U	550 U	500 U	480 U	440 U	420 U	400 U	410 U	370 U	22,000
Pyrene	ug/kg	390 U	710 U	760 U	1100 U	1600 U	610 U	1400	330 J	1300	500 U	480 U	440 U	420 U	400 U	410 U	370 U	220,000

Notes:

U This compound was not detected at or above the associated numerical value. (Quantitation limit shown.)
J Quantitation is approximate due to limitations identified during the quality assurance review (data validation).
UJ This compound was not detected, but the quantitation limit is probably higher due to a low bias identified during the quality assurance review. (Quantitation limit shown.)

Shaded values indicate constituent concentrations which exceed the preliminary site-specific action levels.

TABLE 7-13

80% UCL Concentrations for AOC 5 Soil Samples
BASF - Wyandotte RFI

CONSTITUENT	UNITS	80% UCL (1)	PRELIMINARY SITE-SPECIFIC ACTION LEVEL (PSAL) (2)	80% UCL EXCEED PSAL?
Volatile Organics				
Acetone	ug/kg	61.4	500,000	NO
Carbon disulfide	ug/kg	7.0	32,000	NO
1,1-Dichloroethane	ug/kg	7.4	23,000	NO
Ethylbenzene	ug/kg	7.8	360 ~~620~~	NO
Methyl ethyl ketone	ug/kg	60.2	144,000	NO
m-Xylene & p-Xylene	ug/kg	13.7	1,180	NO
o-Xylene	ug/kg	7.3	1,180	NO
Toluene	ug/kg	7.1	2,200	NO
1,1,1-Trichloroethane	ug/kg	9.7	2,400	NO
Semi-Volatile Organics				
Acenaphthene	ug/kg	342.5	470	NO
Anthracene	ug/kg	350.0	2,200,000	NO
Benzo(a)anthracene	ug/kg	410.3	972	NO
Benzo(b)fluoranthene	ug/kg	413.9	1,310	NO
Benzo(k)fluoranthene	ug/kg	348.5	586	NO
Benzo(ghi)perylene	ug/kg	345.1	687	NO
Benzo(a)pyrene	ug/kg	378.6	881	NO
bis(2-Ethylhexyl) phthalate	ug/kg	330.9	1,180	NO
Chrysene	ug/kg	393.6	794	NO
Dibenzofuran	ug/kg	341.4	260,000	NO
2,4-Dimethylphenol	ug/kg	335.5	600	NO
Di-n-octyl phthalate	ug/kg	346.8	10,000,000	NO
Fluoranthene	ug/kg	510.1	7,400	NO
Fluorene	ug/kg	340.9	280,000	NO
Indeno(1,2,3-cd)pyrene	ug/kg	347.9	671	NO
2-Methylnaphthalene	ug/kg	936.9	680	**YES**
3-Methylphenol	ug/kg	490.0	2,000,000	NO
4-Methylphenol	ug/kg	590.1	124	**YES**
Naphthalene	ug/kg	360.4	680	NO
Phenanthrene	ug/kg	559.6	656	NO
Phenol	ug/kg	1552.3	22,000	NO
Pyrene	ug/kg	529.3	220,000	NO

(1) 80% UCL = Mean + 0.866(Standard Deviation/n^0.5), where n=16

(2) Appropriate Preliminary Site-specific Action Levels (PSALs) for fill were utilized.

TABLE 7-14

Detected Constituent Concentrations for AOC 6 Soil Samples
BASF - Wyandotte RFI

CONSTITUENT	UNITS	SAMPLE ID NUMBERS AND RESULTS								
		SG002A0C6-SP54B	SG002A0C6-SP55A	SG002A0C6-SP58	SG002A0C6-SP61A	SG002A0C6-SP62A	SG002A0C6-SP63	SG002A0C6-SP64	SG002A0C6-SP65	*PRELIMINARY SITE-SPECIFIC ACTION LEVEL (PSAL) (1)*
Volatile Organics										
Benzene	ug/kg	6.5 UJ	6.8 UJ	5.4 U	7.3 UJ	7 UJ	6.4 UJ	2.6 J	31 J	*1,060*
Chloroform	ug/kg	6.5 UJ	6.8 UJ	5.4 U	7.3 UJ	10 J	6.4 U	5.9 U	6.3 UJ	*1,600*
1,2-Dichloropropane	ug/kg	6.5 UJ	6.8 UJ	5.4 U	7.3 UJ	22 J	6.4 UJ	4.7 J	6.3 UJ	*1,280*
Ethylbenzene	ug/kg	6.5 UJ	6.8 UJ	5.4 UJ	7.3 UJ	7 UJ	6.4 UR	5.9 UR	6.3 UR	*620*
1,2-Dichloropropane	ug/kg	6.5 UJ	6.8 UJ	5.4 U	7.3 UJ	22 J	6.4 UJ	4.7 J	6.3 UJ	*1,280*
Ethylbenzene	ug/kg	6.5 UJ	6.8 UJ	5.4 UJ	7.3 UJ	7 UJ	6.4 UR	5.9 UR	6.3 UR	*620*
Methylene chloride	ug/kg	6.5 UJ	6.8 UJ	9.9	7.3 UJ	7 U*	8.6	9	7.3 J	*1,180*
Toluene	ug/kg	6.5 UJ	6.8 UJ	5.4 UJ	7.3 UJ	7 UJ	6.4 UR	5.9 UR	6.3 UR	*2,200*
1,2,3-Trichloropropane	ug/kg	6.5 UJ	6.8 UJ	5.4 UJ	7.3 UJ	9 J	6.4 UR	5.9 UR	6.3 UR	*7*
m-Xylene & p-Xylene	ug/kg	6.5 UJ	6.8 UJ	5.4 UJ	7.3 UJ	7 UJ	6.4 UR	5.9 UR	6.3 UR	*1,180*
o-Xylene	ug/kg	6.5 UJ	6.8 UJ	5.4 UJ	7.3 UJ	7 UJ	6.4 UR	5.9 UR	6.3 UR	*1,180*
Semi-Volatile Organics										
Acenaphthene	ug/kg	430 U	55 J	2400 U	510 J	9300 U	420 U	780 U	830 U	*470*
Acenaphthylene	ug/kg	89 J	230 J	2400 U	350 J	5800 J	58 J	350 J	150 J	*470*
Acetophenone	ug/kg	430 U	300 J	2400 U	1900 U	1900 J	420 U	500 J	420 J	*5,600,000*
Anthracene	ug/kg	190 J	180 J	2400 U	3300	12000	420 U	83 J	830 U	*2,200,000*
Benzo(a)anthracene	ug/kg	910	1100	5400	4800	26000	130 J	460 J	150 J	*972*
Benzo(b)fluoranthene	ug/kg	1200	2200	19000	4500	28000	150 J	900	280 J	*1,310*
Benzo(k)fluoranthene	ug/kg	440	760	5400	2400	10000	50 J	280 J	830 U	*586*
Benzo(ghi)perylene	ug/kg	370 J	120 J	11000	930 J	9900	87 J	420 J	150 J	*687*
Benzo(a)pyrene	ug/kg	850	1200	11000	3400	21000	120 J	440 J	180 J	*881*
bis(2-Chloroisopropyl) ether	ug/kg	430 U	130 J	2400 U	1900 U	3200 J	420 U	140 J	2500	*6,700*
Chrysene	ug/kg	900	990	8400	4100	22000	230 J	540 J	210 J	*794*
Dibenz(a,h)anthracene	ug/kg	110 J	160 J	3000	330 J	4600 J	420 U	120 J	830 U	*580*
Dibenzofuran	ug/kg	57 J	100 J	2400 U	460 J	2600 J	230 J	240 J	220 J	*260,000*
2,4-Dimethylphenol	ug/kg	430 U	450 U	2400 U	1900 U	9300 U	420 U	780 U	170 J	*600*
Fluoranthene	ug/kg	1700	1700	3300	10000	50000	120 J	490 J	240 J	*7,400*
Fluorene	ug/kg	54 J	580	2400 U	1400 J	7700 J	420 U	94 J	96 J	*280,000*
Indeno(1,2,3-cd)pyrene	ug/kg	400 J	100 J	9300	1200 J	12000	73 J	450 J	830 U	*671*
2-Methylnaphthalene	ug/kg	49 J	220 J	2400 U	1900 U	9300 U	680	730 J	800 J	*680*
2-Methylphenol	ug/kg	430 U	450 U	2400 U	1900 U	9300 U	420 U	780 U	140 J	*760*
Naphthalene	ug/kg	43 J	190 J	2400 U	1900 U	2100 J	350 J	360 J	4100	*680*
Phenanthrene	ug/kg	960	800	520 J	9200	45000	650	810	580 J	*656*
Pyrene	ug/kg	1600 J	1300	4200	7600	35000	170 J	570 J	220 J	*220,000*
Metals/Inorganics										
Arsenic	mg/kg	4.9	44.9	3.9	10.7	29.6	25.7	9.9 J	38.3	*12.0*
Barium	mg/kg	75.2	187	21.6	120	104	130	129	75.7	*255.8*
Beryllium	mg/kg	0.65 U	0.68 U	0.54 U	0.89	0.7 U	0.64 U	0.59 U	0.63 U	*1.5*
Cadmium	mg/kg	0.14	1.4	0.17	2	1.4	0.29	0.19	0.14	*2.1*
Chromium	mg/kg	6.2	26.9	5.2	53.2	23.3	9.6	4.4 J	3.9	*23.9*
Copper	mg/kg	9.3	49.4	32.1 J	48.7	35.3	22.4 J	22.6 J	7.4 J	*46 1*
Lead	mg/kg	10.7	308	8.8	65	138	6	20.9 J	13.2	*63.3*
Mercury	mg/kg	0.13 U	0.55	0.11 U	0.53	3.3	0.13 U	0.12 U	0.13 U	*0.8*
Nickel	mg/kg	10.1 J	18.8 J	5.3	31.1 J	33.9 J	13	5.6	5 U	*22.3*
Selenium	mg/kg	1 U*	1.2 U*	0.54 U	0.73 U	1.9 U*	3.2	1.7	1.9	*3.5*
Total Cyanide (2)	mg/kg	0.32 UJ	1 J	0.27 U	1.3 J	2.4 J	0.49	0.3 U	1	*0.1*
Vanadium	mg/kg	10.6	19.5	9.3	18.6	9.3	19.5	7.3	7.3	*41.1*
Zinc	mg/kg	53.9 J	174 J	16.1	156 J	252 J	23.3	24 J	14.3	*216.8*

Notes:

U This compound was not detected at or above the associated numerical value. (Quantitation limit shown.)
U* This compound should be considered "not detected" since it was detected in a blank at a similar level. (Quantitation limit shown.)
J Quantitation is approximate due to limitations identified during the quality assurance review (data validation).
UJ This compound was not detected, but the quantitation limit is probably higher due to a low bias identified during the quality assurance review. (Quantitation limit shown.)
UR Unusable "not detected" result; compound may or may not be present in this sample. (Quantitation limit shown.)

(1) Appropriate Preliminary Site-specific Action Levels (PSALs) for fill were utilized.
(2) Analytical data for total cyanide could only be compared to the more conservative PSAL for amenable cyanide.
Shaded values indicate constituent concentrations which exceed the preliminary site-specific action levels

TABLE 7-15

80% UCL Concentrations for AOC 6 Soil Samples
BASF - Wyandotte RFI

CONSTITUENT	UNITS	80% UCL (1)	PRELIMINARY SITE-SPECIFIC ACTION LEVEL (PSAL) (2)	80% UCL EXCEED PSAL?
Volatile Organics				
Benzene	ug/kg	10	1,060	NO
Chloroform	ug/kg	5	1,600	NO
1,2-Dichloropropane	ug/kg	8	1,280	NO
Ethylbenzene	ug/kg	3	620	NO
1,2-Dichloropropane	ug/kg	8	1,280	NO
Ethylbenzene	ug/kg	3	620	NO
Methylene chloride	ug/kg	7	1,180	NO
Toluene	ug/kg	3	2,200	NO
1,2,3-Trichloropropane	ug/kg	5	7	NO
m-Xylene & p-Xylene	ug/kg	3	1,180	NO
o-Xylene	ug/kg	3	1,180	NO
Semi-Volatile Organics				
Acenaphthene	ug/kg	1,441	470	**YES**
Acenaphthylene	ug/kg	1,650	470	**YES**
Acetophenone	ug/kg	901	5,600,000	NO
Anthracene	ug/kg	3,498	2,200,000	NO
Benzo(a)anthracene	ug/kg	7,653	972	**YES**
Benzo(b)fluoranthene	ug/kg	10,367	1,310	**YES**
Benzo(k)fluoranthene	ug/kg	3,586	586	**YES**
Benzo(ghi)perylene	ug/kg	4,359	687	**YES**
Benzo(a)pyrene	ug/kg	7,149	881	**YES**
bis(2-Chloroisopropyl) ether	ug/kg	1,444	6,700	NO
Chrysene	ug/kg	7,063	794	**YES**
Dibenz(a,h)anthracene	ug/kg	1,661	580	**YES**
Dibenzofuran	ug/kg	915	260,000	NO
2,4-Dimethylphenol	ug/kg	1,484	600	**YES**
Fluoranthene	ug/kg	13,860	7,400	**YES**
Fluorene	ug/kg	2,238	280,000	NO
Indeno(1,2,3-cd)pyrene	ug/kg	4,511	671	**YES**
2-Methylnaphthalene	ug/kg	1,622	680	**YES**
2-Methylphenol	ug/kg	1,481	760	**YES**
Naphthalene	ug/kg	1,594	680	**YES**
Phenanthrene	ug/kg	12,230	656	**YES**
Pyrene	ug/kg	10,089	220,000	NO
Metals/Inorganics				
Arsenic	mg/kg	26.0	12.0	**YES**
Barium	mg/kg	120.9	255.8	NO
Beryllium	mg/kg	0.5	1.5	NO
Cadmium	mg/kg	1.0	2.1	NO
Chromium	mg/kg	22.1	23.9	**NO**
Copper	mg/kg	33.5	46.1	NO
Lead	mg/kg	104.8	63.3	**YES**
Mercury	mg/kg	0.9	0.8	**YES**
Nickel	mg/kg	18.8	22.3	**NO**
Selenium	mg/kg	1.5	3.5	NO
Total Cyanide (3)	mg/kg	1.1	0.1	**YES**
Vanadium	mg/kg	14.4	41.1	NO
Zinc	mg/kg	118.3	216.8	NO

(1) 80% UCL = Mean + 0.896(Standard Deviation/n^0.5), where n=8
(2) Appropriate Preliminary Site-specific Action Levels (PSALs) for fill were utilized.
(3) Analytical data for total cyanide could only be compared to the more conservative PSAL for amenable cyanide.

TABLE 7-16

Detected Constituent Concentrations for AOC 7 Soil Samples
(Vertical Characterization Samples)
BASF - Wyandotte RFI

CONSTITUENT	UNITS	SAMPLE ID NUMBERS AND RESULTS											
		SG002AOC-7 SP01C	SG003AOC-7 SP01D	SG000AOC-7 SP02A	SG001AOC-7 SP02B	SG002AOC-7 SP02C	SG004AOC-7 SP02D	SG006AOC-7 SP02E-S (1)	SG008AOC-7 SP02F-S (1)	SG009AOC-7 SP02G-S (1)	SG010AOC-7 SP02H-S (1)	SG011AOC-7 SP02I (1)	*PRELIMINARY SITE-SPECIFIC ACTION LEVEL (PSAL) (2)*
Metals/Inorganics													
Arsenic	mg/kg	21.6	8.6	NA	NA	NA	44	34.2	NA	2.5	NA	6.8	*12.0*
Barium	mg/kg	61	85.6	NA	NA	NA	99	40.3	NA	8.3	NA	70	*255.8*
Beryllium	mg/kg	0.6 U	0.68 U	NA	NA	NA	0.68 U	0.72 U	NA	0.64 U	NA	0.62 U	*1.5*
Cadmium	mg/kg	0.74	0.75	NA	NA	NA	0.39	0.14 U	NA	0.13 U	NA	0.43	*2.1*
Chromium	mg/kg	20.2	22.1	NA	NA	NA	24.7	29.1	NA	8.3	NA	27	*23.9*
Cobalt	mg/kg	6 U	6.8 U	NA	NA	NA	6.8 U	7.2 U	NA	6.4 U	NA	9.7	*8.9*
Copper	mg/kg	12 J	17.7 J	NA	NA	NA	37 J	24.8 J	NA	2.7 J	NA	20.8 J	*46.1*
Lead	mg/kg	226	335	NA	NA	NA	21.4	6.7	NA	2.8	NA	8.4	*63.3*
Mercury	mg/kg	4.8	3.3	NA	NA	NA	0.51	0.39	NA	0.13 U	NA	0.12 U	*0.8*
Nickel	mg/kg	22.7 J	13.1 J	NA	NA	NA	11.5 J	14.1 J	NA	5.1 UJ	NA	31.8 J	*22.3*
Selenium	mg/kg	0.6 U	0.68 U	NA	NA	NA	1.7	1.1	NA	0.64 U	NA	0.62 U	*3.5*
Silver	mg/kg	1.2 U	1.4 U	NA	NA	NA	1.4 U	1.4 U	NA	1.3 U	NA	1.2 U	*3.0*
Vanadium	mg/kg	27.6	27	NA	NA	NA	39.5	17.1	NA	17.4	NA	41.3	*41.1*
Zinc	mg/kg	105 J	190 J	NA	NA	NA	24.2 J	43 J	NA	13.5 J	NA	62.3 J	*216.8*
Total Cyanide (3)	mg/kg	5.7	4.5	2	1.7	0.32	0.74	4.4	0.31 U	3	1.9	1.2	*0.1*

Notes:

- U This compound was not detected at or above the associated numerical value. (Quantitation limit shown.)
- U* This compound should be considered "not detected" since it was detected in a blank at a similar level. (Quantitation limit shown.)
- J Quantitation is approximate due to limitations identified during the quality assurance review (data validation).
- UJ This compound was not detected, but the quantitation limit is probably higher due to a low bias identified during the quality assurance review. (Quantitation limit shown.)
- NA Not analyzed.

(1) Soil sample IDs containing an "-S" suffix represent saturated soil samples that were collected below the water table.
(2) Appropriate Preliminary Site-specific Action Levels (PSALs) for fill were utilized.
(3) Analytical data for total cyanide could only be compared to the more conservative PSAL for amenable cyanide.
Shaded values indicate constituent concentrations which exceed the preliminary site-specific action levels.

TABLE 7-17

Detected Constituent Concentrations for AOC 7 Soil Samples
(Horizontal Delineation Samples)
BASF - Wyandotte RFI

		SAMPLE ID NUMBERS AND RESULTS (AOC 7A: Northwest Corner of Facility)								
CONSTITUENT	UNITS	SG002AOC-7 SP03	SG003AOC-7 SP04	SG003AOC-7 SP05	SG003AOC-7 SP06	SG002AOC-7 SP07	SG003AOC-7 SP08B	SG003AOC-7 SP09A (MS/MSD)	SG004AOC-7 SP10A	*PRELIMINARY SITE-SPECIFIC ACTION LEVEL (PSAL) (1)*
Metals/Inorganics										
Arsenic	mg/kg	4.5	8.6	15.6	17.8	10.5	5.1	5	49 J	*12.0*
Barium	mg/kg	25.2	148	121	104	27.6	22.6	57	33.5	*255.8*
Beryllium	mg/kg	0.53 U	0.74 U	0.66 U	0.71	0.6 U	0.62 U	0.6 U	1.1	*1.5*
Cadmium	mg/kg	0.22	0.29	0.45	0.14	0.46	0.18	0.25	0.12 U	*2.1*
Chromium	mg/kg	7.3	12.3	10.3	7.4	11.4	17.4	14.9	5.6	*23.9*
Copper	mg/kg	6.9	20.5	31.6	28.8	21.8	31 J	21.5 J	18.3 J	*46.1*
Lead	mg/kg	18.8	16.1	29.1	11.7	52.8	81.5 J	84.9 J	14.7 J	*63.3*
Mercury	mg/kg	0.22 J	1.5 J	1.7 J	0.12 U	0.13 J	0.12	2.8	1.1 J	*0.8*
Nickel	mg/kg	11.5	13.4	14.9	10.3	12.6	16.4	8.1	11.1	*22.3*
Selenium	mg/kg	0.53 U	0.74 U	0.66 U	1.6	0.6 U	0.62 U	0.6 U	0.97	*3.5*
Silver	mg/kg	1.1 U	1.5 U	1.3 U	1.2 U	1.2 U	1.2 U	1.2 U	19.4	*3.0*
Vanadium	mg/kg	11.9	31	25.7	17.2	19.9	9.3	13.1	11.5	*41.1*
Zinc	mg/kg	71.3 J	96 J	72 J	12.6 J	54.5 J	25.6 J	94.1 J	32.1 J	*216.8*
Total Cyanide	mg/kg	0.27 UJ	1.5 J	2.7 J	0.48 J	0.3 UJ	0.31 U	0.49	0.3 U	*0.1*

		SAMPLE ID NUMBERS AND RESULTS (AOC 7B: Adjacent to Steam Plant)				SAMPLE ID NUMBERS AND RESULTS (AOC 7C: Central Portion of Facility)				
CONSTITUENT	UNITS	SG002A0C-7 SP33	SG005A0C-7 SP34	SG002A0C-7 SP35	SG003A0C-7 SP36	SG003AOC-7 SP37	SG003AOC-7 SP38	SG004AOC-7 SP39	SG003AOC-7 SP40	*PRELIMINARY SITE-SPECIFIC ACTION LEVEL (PSAL) (1)*
Metals/Inorganics										
Arsenic	mg/kg	6.6	1.7	11.7	9.8	34.5	25	27.9	19.2	*12.0*
Barium	mg/kg	108	12.6	52.1	37.4	47.9 J	20.7 J	147	39.6 J	*255.8*
Beryllium	mg/kg	0.64 U	0.6 U	0.78	0.56 U	0.67 U	0.7 U	0.64 U	1.3	*1.5*
Cadmium	mg/kg	0.51	0.12 U	0.11 U	0.41	0.13 UJ	0.14 UJ	0.67 J	0.14 UJ	*2.1*
Chromium	mg/kg	8.6 J	26.9 J	6.4 J	10.4 J	6.9	6	17.2	6.4	*23.9*
Copper	mg/kg	12.4	4.7 U*	15	16.5	30.8	22	21.6	20	*46.1*
Lead	mg/kg	14.2	3.4	12.9	30.6	35.1 J	10 J	113 J	7.3 J	*63.3*
Mercury	mg/kg	0.27	0.12 U	0.11 U	0.57	0.16	0.14 U	2.2	0.14 U	*0.8*
Nickel	mg/kg	12.6	6.4	9.5	13.8	10.1	20.1	89.9	14.3	*22.3*
Selenium	mg/kg	0.64 UJ	0.6 UJ	0.56 UJ	0.56 UJ	2.3	2.4	2	2.2	*3.5*
Silver	mg/kg	1.3 UJ	1.2 UJ	1.1 UJ	1.1 UJ	1.3 U	1.4 U	1.3 U	1.4 U	*3.0*
Vanadium	mg/kg	17.8	10.1	10.1	18.9	14.6	11.9	17.3	19.5	*41.1*
Zinc	mg/kg	151 J	15.4 J	14.6 J	77 J	46	18.8 J	603	18.3 J	*216.8*
Total Cyanide	mg/kg	0.32 UJ	0.3 UJ	0.28 UJ	0.28 UJ	0.34 UJ	0.35 UJ	0.32 UJ	0.36 UJ	*0.1*

Notes:

- U This compound was not detected at or above the associated numerical value (Quantitation limit shown.)
- U* This compound should be considered "not detected" since it was detected in a blank at a similar level. (Quantitation limit shown.)
- J Quantitation is approximate due to limitations identified during the quality assurance review (data validation).
- UJ This compound was not detected, but the quantitation limit is probably higher due to a low bias identified during the quality assurance review. (Quantitation limit shown.)
- (1) Appropriate Preliminary Site-specific Action Levels (PSALs) for fill were utilized.
  Shaded values indicate constituent concentrations which exceed the preliminary site-specific action levels.

TABLE 7-18

80% UCL Concentrations for AOC 7A Soil Samples
(Vertical Characterization Samples for AOC 7A: Northwest Corner of Facility)
BASF - Wyandotte RFI

CONSTITUENT	UNITS	80% UCL (1)	PRELIMINARY SITE-SPECIFIC ACTION LEVEL (PSAL) (2)	80% UCL EXCEED PSAL?
Metals/Inorganics				
Arsenic	mg/kg	25.9	12.0	**YES**
Barium	mg/kg	73.0	255.8	NO
Beryllium	mg/kg	0.3	1.5	NO
Cadmium	mg/kg	0.5	2.1	NO
Chromium	mg/kg	24.7	23.9	**YES**
Cobalt	mg/kg	5.4	8.9	NO
Copper	mg/kg	23.5	46.1	NO
Lead	mg/kg	154.2	63.3	**YES**
Mercury	mg/kg	2.3	0.8	**YES**
Nickel	mg/kg	19.7	22.3	NO
Selenium	mg/kg	0.9	3.5	NO
Silver	mg/kg	0.7	3.0	NO
Vanadium	mg/kg	32.2	41.1	NO
Zinc	mg/kg	97.7	216.8	NO
Total Cyanide (3)	mg/kg	2.8	0.1	**YES**

(1) 80% UCL = Mean + 0.920(Standard Deviation/n^0.5), where n=6 for metals;
and 80% UCL = Mean + 0.879(Standard Deviation/n^0.5), where n=11 for total cyanide.
(2) Appropriate Preliminary Site-specific Action Levels (PSALs) for fill were utilized.
(3) Analytical data for total cyanide could only be compared to the more conservative PSAL for amenable cyanide.

TABLE 7-19

80% UCL Concentrations for AOC 7A Soil Samples
(Horizontal Delineation Samples for AOC 7A: Northwest Corner of Facility)
BASF - Wyandotte RFI

CONSTITUENT	UNITS	80% UCL (1)	PRELIMINARY SITE-SPECIFIC ACTION LEVEL (PSAL) (2)	80% UCL EXCEED PSAL?
Metals/Inorganics				
Arsenic	mg/kg	19.2	12.0	**YES**
Barium	mg/kg	83.1	255.8	NO
Beryllium	mg/kg	0.6	1.5	NO
Cadmium	mg/kg	0.3	2.1	NO
Chromium	mg/kg	12.1	23.9	NO
Copper	mg/kg	25.1	46.1	NO
Lead	mg/kg	48.3	63.3	NO
Mercury	mg/kg	1.3	0.8	**YES**
Nickel	mg/kg	13.1	22.3	NO
Selenium	mg/kg	0.7	3.5	NO
Silver	mg/kg	5.1	3.0	**YES**
Vanadium	mg/kg	19.9	41.1	NO
Zinc	mg/kg	67.2	216.8	NO
Total Cyanide (3)	mg/kg	1.0	0.1	**YES**

(1) 80% UCL = Mean + 0.896(Standard Deviation/n^0.5), where n=8
(2) Appropriate Preliminary Site-specific Action Levels (PSALs) for fill were utilized.
(3) Analytical data for total cyanide could only be compared to the more conservative PSAL for amenable cyanide.

TABLE 7-20

80% UCL Concentrations for AOC 7B Soil Samples
(Horizontal Delineation Samples for AOC 7B: Adjacent to Steam Plant)
BASF - Wyandotte RFI

CONSTITUENT	UNITS	80% UCL (1)	PRELIMINARY SITE-SPECIFIC ACTION LEVEL (PSAL) (2)	80% UCL EXCEED PSAL?
Metals/Inorganics				
Arsenic	mg/kg	9.6	12.0	NO
Barium	mg/kg	72.3	255.8	NO
Beryllium	mg/kg	0.5	1.5	NO
Cadmium	mg/kg	0.4	2.1	NO
Chromium	mg/kg	17.7	23.9	NO
Copper	mg/kg	14.7	46.1	NO
Lead	mg/kg	20.8	63.3	NO
Mercury	mg/kg	0.4	0.8	NO
Nickel	mg/kg	12.2	22.3	NO
Selenium	mg/kg	0.3	3.5	NO
Silver	mg/kg	0.6	3.0	NO
Vanadium	mg/kg	16.6	41.1	NO
Zinc	mg/kg	96.1	216.8	NO
Total Cyanide (3)	mg/kg	0.2	0.1	YES

(1) 80% UCL = Mean + 0.978(Standard Deviation/n^0.5), where n=4
(2) Appropriate Preliminary Site-specific Action Levels (PSALs) for fill were utilized.
(3) Analytical data for total cyanide could only be compared to the more conservative PSAL for amenable cyanide.

TABLE 7-21

80% UCL Concentrations for AOC 7C Soil Samples
(Horizontal Delineation Samples for AOC 7C: Central Portion of Facility)
BASF - Wyandotte RFI

CONSTITUENT	UNITS	80% UCL (1)	PRELIMINARY SITE-SPECIFIC ACTION LEVEL (PSAL) (2)	80% UCL EXCEED PSAL?
Metals/Inorganics				
Arsenic	mg/kg	29.8	12.0	**YES**
Barium	mg/kg	91.5	255.8	NO
Beryllium	mg/kg	0.8	1.5	NO
Cadmium	mg/kg	0.4	2.1	NO
Chromium	mg/kg	11.8	23.9	NO
Copper	mg/kg	26.0	46.1	NO
Lead	mg/kg	65.5	63.3	**YES**
Mercury	mg/kg	1.1	0.8	**YES**
Nickel	mg/kg	52.1	22.3	**YES**
Selenium	mg/kg	2.3	3.5	NO
Silver	mg/kg	0.7	3.0	NO
Vanadium	mg/kg	17.4	41.1	NO
Zinc	mg/kg	312.3	216.8	**YES**
Total Cyanide (3)	mg/kg	0.2	0.1	**YES**

(1) 80% UCL = Mean + 0.978(Standard Deviation/n^0.5), where n=4
(2) Appropriate Preliminary Site-specific Action Levels (PSALs) for fill were utilized.
(3) Analytical data for total cyanide could only be compared to the more conservative PSAL for amenable cyanide.

TABLE 7-22

Detected Constituent Concentrations for Groundwater Samples from Background Monitoring Well RFIMW-24
BASF - Wyandotte RFI

CONSTITUENT	UNITS	MONTHLY (1st QUARTER) SAMPLING EVENT			QUARTERLY SAMPLING EVENT			MEAN
		1st Monthly 9/16/96	2nd Monthly 10/28/96	3rd Monthly 11/19/96	2nd Quarterly 12/20/96	3rd Quarterly 3/18/97	4th Quarterly 6/5/97	
Volatile Organics								
Benzene	ug/L	1 UJ	1 U	1 U	1 U	0.11 J	1 UJ	0.403
Methylene chloride	ug/L	1 UJ	1 U	0.45 J	1 U*	1 U	1 U*	0.496
Semi-Volatile Organics								
bis(2-Ethylhexyl) phthalate	ug/L	3.1 J	5 U	5 U	4.1 J	10 UR	2 J	2.933
Metals/Inorganics (Filtered)								
Arsenic	mg/L	0.0052	0.005 U	0.005 U	0.005 U	0.005 U	0.005 UJ	0.003
Barium	mg/L	0.1	0.078	0.041	0.039	0.082	0.042	0.059
Chromium	mg/L	0.005 U	0.005 U	0.005 U	0.005 U	0.017	0.005 U	0.006
Nickel	mg/L	0.04 U	0.04 U	0.04 U	0.04 U	0.1	0.38 R	0.047
Selenium	mg/L	0.005 U	0.005 UJ	0.0076	0.0076 U*	0.005 UJ	0.005 U	0.003
Metals/Inorganics (Unfiltered)								
Arsenic	mg/L	0.011	0.012 U*	0.0069 U*	0.005 U	0.005 UJ	0.005 UJ	0.004
Barium	mg/L	0.12	0.11	0.064 J	0.061	0.091	0.054	0.076
Chromium	mg/L	0.017	0.16	0.44 J	0.036	0.62	0.36 J	0.305
Copper	mg/L	0.018	0.02	0.021	0.01 U	0.02 U*	0.025 U*	0.012
Lead	mg/L	0.0055 J	0.0071 J	0.0055	0.0031 U*	0.0043	0.0055	0.004
Nickel	mg/L	0.04 U	0.042	0.068 J	0.04 U	0.16	0.16 R	0.074
Selenium	mg/L	0.005 U	0.005 UJ	0.0069	0.012 U*	0.005 U	0.005 U	0.004
Total Cyanide	mg/L	0.052 J	0.54	0.45 J	0.53	0.36	0.63 J	0.467
Vanadium	mg/L	0.02 U	0.023	0.02 U	0.02 U	0.02 U	0.02 U	0.011
Zinc	mg/L	0.075 U*	0.046	0.037 U*	0.034 U*	0.051 J	0.075 U*	0.035

Notes:

- U This compound was not detected at or above the associated numerical value. (Quantitation limit shown.)
- U* This compound should be considered "not detected" since it was detected in a blank at a similar level. (Quantitation limit shown.)
- J Quantitation is approximate due to limitations identified during the quality assurance review (data validation).
- R Unusable result; compound may or may not be present in this sample.
- UJ This compound was not detected, but the quantitation limit is probably higher due to a low bias identified during the quality assurance review. (Quantitation limit shown.)
- UR Unusable "not detected" result; compound may or may not be present in this sample. (Quantitation limit shown.)

Background calculations were initially performed to determine a mean value for the results from the first three monthly events. This mean value was then used with the results from the remaining three quarterly sampling events to determine the annual mean value.

R and UR flagged values are not included in the associated statistical calculations because these results are considered unusable.

TABLE 7-23

Detected Constituent Concentrations for Groundwater Samples from Background Monitoring Well RFIMW-25
BASF - Wyandotte RFI

CONSTITUENT	UNITS	MONTHLY (1st QUARTER) SAMPLING EVENT 1st Monthly 9/16/96	2nd Monthly 10/28/96	3rd Monthly 11/19/96	QUARTERLY SAMPLING EVENT 2nd Quarterly 12/20/96	2nd Quarterly (MW-25D)	3rd Quarterly 3/18/97	4th Quarterly 6/5/97	MEAN
Metals/Inorganics (Filtered)									
Barium	mg/L	0.26	0.2	0.11	0.11	0.13	0.13	0.2	0.160
Cadmium	mg/L	0.0016	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001
Chromium	mg/L	0.005 U	0.005 U	0.005 U	0.005 J	0.005 U	0.005 U	0.005 U	0.003
Copper	mg/L	0.011 J	0.01 U	0.01	0.01 U	0.01 U	0.01 U	0.01 U	0.006
Nickel	mg/L	0.04 U	0.14	0.12	0.12	0.14	0.04 U	0.04 U	0.066
Zinc	mg/L	0.11	0.028 J	0.03 U*	0.02 U*	0.02 U	0.022 U*	0.052 U*	0.025
Metals/Inorganics (Unfiltered)									
Arsenic	mg/L	0.0078	0.026 J	0.021	0.005 U	0.005 U	0.005 UJ	0.018 J	0.010
Barium	mg/L	0.27	0.25	0.18 J	0.13	0.14	0.17	0.27	0.202
Cadmium	mg/L	0.0011	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.0016	0.001
Chromium	mg/L	0.19	0.98	0.44 J	0.67 J	0.21 J	0.62	1.4 J	0.749
Copper	mg/L	0.031	0.061	0.04	0.018	0.011	0.019 U*	0.04 J	0.027
Lead	mg/L	0.004 J	0.017 J	0.013	0.0041 U*	0.003 U	0.0036	0.011	0.007
Nickel	mg/L	0.057	0.21	0.29 J	0.13	0.14	0.062	0.16	0.136
Total Cyanide	mg/L	0.028 J	0.54	0.41 J	0.31	0.32	0.38	0.44 J	0.365
Vanadium	mg/L	0.02 U	0.091	0.061 J	0.02 U	0.02 U	0.02 U	0.057	0.033
Zinc	mg/L	0.13	0.19	0.13 J	0.075 U*	0.048 U*	0.057 J	0.17 U*	0.081

Notes:

U This compound was not detected at or above the associated numerical value. (Quantitation limit shown.)
U* This compound should be considered "not detected" since it was detected in a blank at a similar level. (Quantitation limit shown.)
J Quantitation is approximate due to limitations identified during the quality assurance review (data validation).
UJ This compound was not detected, but the quantitation limit is probably higher due to a low bias identified during the quality assurance review. (Quantitation limit shown.)

Background calculations were initially performed to determine a mean value for the results from the first three monthly events. This mean value was then used with the results from the remaining three quarterly sampling events to determine the annual mean value.

TABLE 7-24

Detected Constituent Concentrations for Groundwater Samples from Background Monitoring Well RFIMW-26
BASF - Wyandotte RFI

CONSTITUENT	UNITS	MONTHLY (1st QUARTER) SAMPLING EVENT 1st Monthly 9/16/96	2nd Monthly 10/28/96	3rd Monthly 11/19/96	QUARTERLY SAMPLING EVENT 2nd Quarterly 12/20/96	3rd Quarterly 3/18/97	4th Quarterly 6/5/97	MEAN
Metals/Inorganics (Filtered)								
Barium	mg/L	0.85	0.62	0.42	0.39	1.6	0.42	0.760
Cadmium	mg/L	0.0014	0.001 U	0.001 U	0.001 U	0.002	0.001 U	0.001
Chromium	mg/L	0.005 U	0.005 U	0.005 UJ	0.018	0.0075 J	0.005 UJ	0.008
Copper	mg/L	0.012 J	0.01 U	0.013 J	0.01 J	0.018 U*	0.015 U*	0.009
Nickel	mg/L	0.23	0.68	0.45	1.5	0.27	0.22	0.611
Zinc	mg/L	0.056 U*	0.02 UJ	0.02 UJ	0.054	0.023 U*	0.024 U*	0.023
Metals/Inorganics (Unfiltered)								
Arsenic	mg/L	0.018	0.075 J	0.033	0.0082	0.0087 J	0.038 J	0.024
Barium	mg/L	0.91	0.73	0.57 J	0.45	1.4	0.68	0.817
Cadmium	mg/L	0.001 U	0.001 U	0.001 U	0.001 U	0.0014	0.0019	0.001
Chromium	mg/L	0.16	2.8	1.5 J	3.3	1.8	6.4 J	3.247
Cobalt	mg/L	0.05 U	0.052	0.05 U	0.05 U	0.05 U	0.05 U	0.027
Copper	mg/L	0.037	0.19	0.082	0.035	0.054	0.15	0.086
Lead	mg/L	0.011 J	0.053 J	0.021	0.0056 U*	0.006	0.024	0.015
Mercury	mg/L	0.0002 U	0.0004	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0001
Nickel	mg/L	0.3	1.4	0.81 J	0.86	0.25	1	0.737
Total Cyanide	mg/L	0.005 UJ	0.009 J	0.005 U	0.007	0.21	0.32 J	0.135
Vanadium	mg/L	0.039	0.14	0.067 J	0.028	0.022	0.072	0.051
Zinc	mg/L	0.086 U*	0.28	0.12 J	0.083 U*	0.069 J	0.16 U*	0.085

Notes:

U This compound was not detected at or above the associated numerical value. (Quantitation limit shown.)
U* This compound should be considered "not detected" since it was detected in a blank at a similar level. (Quantitation limit shown.)
J Quantitation is approximate due to limitations identified during the quality assurance review (data validation).
UJ This compound was not detected, but the quantitation limit is probably higher due to a low bias identified during the quality assurance review. (Quantitation limit shown.)

Background calculations were initially performed to determine a mean value for the results from the first three monthly events. This mean value was then used with the results from the remaining three quarterly sampling events to determine the annual mean value.

TABLE 7-25

Detected Constituent Concentrations for Groundwater Samples from Background Monitoring Well RFIMW-27
BASF - Wyandotte RFI

		MONTHLY (1st QUARTER) SAMPLING EVENT			QUARTERLY SAMPLING EVENT			
CONSTITUENT	UNITS	1st Monthly 9/16/96	2nd Monthly 10/28/96	3rd Monthly 11/19/96	2nd Quarterly 12/20/96	3rd Quarterly 3/18/97	4th Quarterly 6/6/97	MEAN
Volatile Organics								
Benzene	ug/L	1 UJ	1 U	1 U	1 U	1 U	0.11 J	0.403
Semi-Volatile Organics								
bis(2-Ethylhexyl) phthalate	ug/L	5 U	5 U	5 U	5 UR	5 UR	4.1 J	3.300
Metals/Inorganics (Filtered)								
Barium	mg/L	0.2	0.24	0.22	0.22	0.22	0.18	0.210
Cadmium	mg/L	0.0012	0.002 U	0.001 U	0.001 U	0.002 U	0.0011	0.001
Chromium	mg/L	0.005 U	0.01 U	0.005 UJ	0.005 U	0.01 J	0.0087 U*	0.005
Zinc	mg/L	0.1 U*	0.02 UJ	0.03 U*	0.041	0.02 UJ	0.032 U*	0.023
Metals/Inorganics (Unfiltered)								
Arsenic	mg/L	0.0059	0.01 U	0.011 U*	0.005 U	0.01 UJ	0.005 UJ	0.004
Barium	mg/L	0.23	0.26	0.2 J	0.23	0.22	0.18	0.215
Cadmium	mg/L	0.0011	0.002 U	0.001 U	0.001 U	0.002 U	0.001 U	0.001
Chromium	mg/L	0.035	0.021	0.024 J	0.0065	0.012	0.014 J	0.015
Copper	mg/L	0.015 J	0.022	0.01 U	0.01 U	0.052 J	0.022 U*	0.021
Lead	mg/L	0.003 UJ	0.0073 J	0.003 U	0.003 UJ	0.006 UJ	0.003 U	0.002
Silver	mg/L	0.01 U	0.01 U	0.015	0.01 U	0.01 U	0.01 U	0.006
Total Cyanide	mg/L	0.006 J	0.005 UJ	0.017	0.022	0.041	0.048	0.030
Vanadium	mg/L	0.02 U	0.023	0.02 U	0.02 U	0.02 U	0.02 U	0.011
Zinc	mg/L	0.077 U*	0.059 J	0.031 U*	0.023 U*	0.02 U*	0.34 J	0.100

Notes:

U This compound was not detected at or above the associated numerical value. (Quantitation limit shown.)
U* This compound should be considered "not detected" since it was detected in a blank at a similar level. (Quantitation limit shown.)
J Quantitation is approximate due to limitations identified during the quality assurance review (data validation).
UJ This compound was not detected, but the quantitation limit is probably higher due to a low bias identified during the quality assurance review. (Quantitation limit shown.)
UR Unusable "not detected" result; compound may or may not be present in this sample. (Quantitation limit shown.)

Background calculations were initially performed to determine a mean value for the results from the first three monthly events. This mean value was then used with the results from the remaining three quarterly sampling events to determine the annual mean value.

R and UR flagged values are not included in the associated statistical calculations because these results are considered unusable.

TABLE 7-26

Detected Constituent Concentrations for Groundwater Samples from Background Monitoring Well RFIMW-29
BASF - Wyandotte RFI

		MONTHLY (1st QUARTER) SAMPLING EVENT					QUARTERLY SAMPLING EVENT			
CONSTITUENT	UNITS	1st Monthly 10/1/96	1st Monthly (MW-30)	2nd Monthly 10/29/96	3rd Monthly 11/20/96	3rd Monthly (MW-29D)	2nd Quarterly 12/20/96	3rd Quarterly 3/21/97	4th Quarterly 6/4/97	MEAN
Volatile Organics										
Carbon disulfide	ug/L	1 UR	1 UR	1 U	1 U	1 U	1 U	0.099 J	0.75 J	#DIV/0!
Chloroform	ug/L	1 UR	1 UR	1 U	1 U	1 U	1.9	1.6 U*	1 U*	#DIV/0!
Semi-Volatile Organics										
bis(2-Ethylhexyl) phthalate	ug/L	5 U	5 U	5 U	5 U	5 U	2.9 J	11 U*	5 U	3.350
Metals/Inorganics (Filtered)										
Antimony	mg/L	0.0083 U*	0.012 U*	0.005 U	0.0071	0.0064 J	0.0083	0.0059 U*	0.005 U	0.005
Barium	mg/L	0.15	0.16	0.16	0.15 R	0.15 J	0.057	0.087	0.19	0.122
Nickel	mg/L	0.04 U	0.04 U	0.04 U	0.081	0.091	0.04 U	0.72	0.33	0.278
Metals/Inorganics (Unfiltered)										
Antimony	mg/L	0.012 U*	0.012 U*	0.0085 U*	0.0094	0.0065 J	0.007	0.006 U*	0.0075 U*	0.005
Arsenic	mg/L	0.03	0.031	0.023 J	0.0056 U*	0.012 U*	0.0085	0.005 U	0.011 J	0.010
Barium	mg/L	0.22	0.2	0.2	0.08 R	0.12 J	0.11	0.066	0.23	0.146
Cadmium	mg/L	0.0011	0.0011	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.0014	0.001
Chromium	mg/L	0.11	0.1	0.063	0.2 J	0.35 J	0.065	0.23	0.055 J	0.124
Copper	mg/L	0.046	0.054	0.047	0.027 J	0.041 J	0.015	0.022 U*	0.022 U*	0.020
Lead	mg/L	0.018	0.02	0.014 J	0.0048 J	0.0082 J	0.0052 U*	0.0066 J	0.0067	0.007
Nickel	mg/L	0.078	0.085	0.05	0.17 J	0.26 J	0.04 U	1.1	0.43	0.416
Total Cyanide	mg/L	0.035 J	0.031 J	0.005 UJ	0.025	0.022	0.008	0.01	0.021 J	0.015
Vanadium	mg/L	0.055	0.062	0.051	0.02 U	0.032 J	0.02	0.02 U	0.02	0.023
Zinc	mg/L	0.12	0.13	0.097	0.032 U*	0.077 J	0.042 U*	0.04 U*	0.078 U*	0.042

Notes:

U This compound was not detected at or above the associated numerical value. (Quantitation limit shown.)
U* This compound should be considered "not detected" since it was detected in a blank at a similar level. (Quantitation limit shown.)
J Quantitation is approximate due to limitations identified during the quality assurance review (data validation).
R Unusable result; compound may or may not be present in this sample.
UJ This compound was not detected, but the quantitation limit is probably higher due to a low bias identified during the quality assurance review. (Quantitation limit shown.)
UR Unusable "not detected" result; compound may or may not be present in this sample. (Quantitation limit shown.)

Background calculations were initially performed to determine a mean value for the results from the first three monthly events. This mean value was then used with the results from the remaining three quarterly sampling events to determine the annual mean value.

R and UR flagged values are not included in the associated statistical calculations because these results are considered unusable.

TABLE 7-27

Detected Constituent Concentrations for Groundwater Samples from Background Monitoring Well P-34-N
BASF - Wyandotte RFI

CONSTITUENT	UNITS	MONTHLY (1st QUARTER) SAMPLING EVENT 1st Monthly 9/17/96	2nd Monthly 10/29/96	3rd Monthly 11/20/96	QUARTERLY SAMPLING EVENT 2nd Quarterly 12/20/96	3rd Quarterly 3/18/97	4th Quarterly 6/6/97	MEAN
Semi-Volatile Organics								
Diethyl phthalate	ug/L	5 U	5 U	1.7	5 UR	5 UR	5 U	2.367
1,4-Dioxane	ug/L	3 J	3 J	50 U	3.6 J	50 UR	50 U	12.978
Metals/Inorganics (Filtered)								
Arsenic	mg/L	0.022	0.016 U*	0.0071 U*	0.0064	0.008 J	0.0098 J	0.009
Barium	mg/L	0.1	0.1	0.097	0.091	0.11	0.15	0.113
Lead	mg/L	0.0038 J	0.003 UJ	0.003 U	0.003 U	0.003 U	0.003 U	0.002
Nickel	mg/L	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04[illegible]	0.025
Zinc	mg/L	0.087	0.02 U	0.02 U	0.042	0.022 U*	0.039 U*	0.027
Metals/Inorganics (Unfiltered)								
Arsenic	mg/L	0.069	0.27 J	0.04	0.016	0.051 J	0.093 J	0.072
Barium	mg/L	0.23	0.27	0.15 J	0.095	0.13	0.23	0.168
Cadmium	mg/L	0.0016	0.0013	0.001 U	0.001 U	0.001 U	0.0019	0.001
Chromium	mg/L	0.045	0.05	0.014 J	0.005 U	0.008	0.034 J	0.020
Copper	mg/L	0.046	0.057	0.018	0.01 U	0.01 U	0.043 J	0.023
Lead	mg/L	0.032 J	0.06 J	0.017	0.014	0.012	0.041	0.026
Nickel	mg/L	0.048	0.055	0.04 U	0.04 U	0.04 U	0.094	0.044
Total Cyanide	mg/L	0.005 J	0.022 J	0.02	0.022	0.021	0.02	0.020
Vanadium	mg/L	0.073	0.087	0.026 J	0.02 U	0.02 U	0.055	0.034
Zinc	mg/L	0.26	0.33	0.09 J	0.034 U*	0.07 J	0.22 U*	0.106

Notes:

- U This compound was not detected at or above the associated numerical value. (Quantitation limit shown.)
- U* This compound should be considered "not detected" since it was detected in a blank at a similar level. (Quantitation limit shown.)
- J Quantitation is approximate due to limitations identified during the quality assurance review (data validation).
- UJ This compound was not detected, but the quantitation limit is probably higher due to a low bias identified during the quality assurance review. (Quantitation limit shown.)
- UR Unusable "not detected" result; compound may or may not be present in this sample. (Quantitation limit shown.)

Background calculations were initially performed to determine a mean value for the results from the first three monthly events. This mean value was then used with the results from the remaining three quarterly sampling events to determine the annual mean value.

R and UR flagged values are not included in the associated statistical calculations because these results are considered unusable.

TABLE 7-28

Summary of Mean Constituent Concentrations for Groundwater Samples from Background Monitoring Wells
BASF - Wyandotte RFI

		WELL NO. AND MEAN CONSTITUENT CONCENTRATIONS						
CONSTITUENT	UNITS	MW-24	MW-25	MW-26	MW-27	MW-29	P-34-N	MEAN
Volatile Organics								
Benzene	ug/L	0.403	0.500	0.500	0.403	0.500	0.500	0.468
Carbon disulfide	ug/L	0.500	0.500	0.500	0.500	0.462	0.500	0.494
Chloroform	ug/L	0.500	0.500	0.500	0.500	0.925	0.500	0.571
Methylene chloride	ug/L	0.496	0.500	0.500	0.500	0.500	0.500	0.499
Semi-Volatile Organics								
bis(2-Ethylhexyl) phthalate	ug/L	2.933	2.500	2.500	3.300	3.350	2.500	2.847
Diethyl phthalate	ug/L	2.500	2.500	2.500	2.500	2.500	2.367	2.478
1,4-Dioxane	ug/L	25.000	25.000	25.000	25.000	25.000	12.978	22.996
Metals/Inorganics (Filtered)								
Antimony	mg/L	0.003	0.003	0.003	0.003	0.005	0.003	0.003
Arsenic	mg/L	0.003	0.003	0.003	0.003	0.003	0.009	0.004
Barium	mg/L	0.059	0.160	0.760	0.210	0.122	0.113	0.237
Cadmium	mg/L	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Chromium	mg/L	0.006	0.003	0.008	0.005	0.003	0.003	0.004
Copper	mg/L	0.005	0.006	0.009	0.011	0.005	0.005	0.007
Lead	mg/L	0.002	0.002	0.002	0.002	0.002	0.002	0.002
Nickel	mg/L	0.047	0.066	0.611	0.020	0.278	0.025	0.174
Selenium	mg/L	0.003	0.003	0.003	0.003	0.003	0.003	0.003
Zinc	mg/L	0.013	0.025	0.023	0.023	0.013	0.027	0.021
Metals/Inorganics (Unfiltered)								
Antimony	mg/L	0.003	0.003	0.003	0.003	0.005	0.003	0.003
Arsenic	mg/L	0.004	0.010	0.024	0.004	0.010	0.072	0.021
Barium	mg/L	0.076	0.202	0.817	0.215	0.146	0.168	0.271
Cadmium	mg/L	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Chromium	mg/L	0.305	0.749	3.247	0.015	0.124	0.020	0.743
Cobalt	mg/L	0.025	0.025	0.027	0.025	0.025	0.025	0.025
Copper	mg/L	0.012	0.027	0.086	0.021	0.020	0.023	0.031
Lead	mg/L	0.004	0.007	0.015	0.002	0.007	0.026	0.010
Mercury	mg/L	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
Nickel	mg/L	0.074	0.136	0.737	0.020	0.416	0.044	0.238
Selenium	mg/L	0.004	0.003	0.003	0.003	0.003	0.003	0.003
Silver	mg/L	0.005	0.005	0.005	0.006	0.005	0.005	0.005
Total Cyanide	mg/L	0.467	0.365	0.135	0.030	0.015	0.020	0.172
Vanadium	mg/L	0.011	0.033	0.051	0.011	0.023	0.034	0.027
Zinc	mg/L	0.035	0.081	0.085	0.100	0.042	0.106	0.075

Note: The constituents listed represent the detected constituents from the monitoring wells shown on Tables 7-22 through 7-27.

TABLE 7-29

Detected Constituent Concentrations and PSAL Comparison for Groundwater Samples from Perimeter Monitoring Well RFIMW-1
BASF - Wyandotte RFI

		QUARTERLY SAMPLING EVENT				STATISTICAL VALUES			
CONSTITUENT	UNITS	1st Quarterly 9/25/96	2nd Quarterly 12/17/96	3rd Quarterly 3/24/97	4th Quarterly 6/2/97	MEAN	80% UCL (1)	PSAL	80% UCL Exceed PSAL?
Volatile Organics									
Carbon disulfide	ug/L	1 UJ	1 U	1 U	0.16 J	0.42	0.50	1600.00	No
Vinyl chloride	ug/L	1 UJ	1.1	1 U	0.75 J	0.71	0.85	3.10	No
Semi-Volatile Organics									
1,4-Dioxane	ug/L	210 J	190 J	190 J	150 J	185	197	2000	No
Metals/Inorganics (Filtered)									
Antimony	mg/L	0.0056	0.005 U	0.005 U	0.005 U	0.003	0.004	0.050	No
Arsenic	mg/L	0.005 U	0.0064	0.005 U	0.0076	0.005	0.006	0.050	No
Barium	mg/L	0.26	0.31	0.27	0.25	0.273	0.285	0.630	No
Cadmium	mg/L	0.0011	0.001 U	0.001 U	0.001 U	0.0007	0.0008	0.0008	No
Zinc	mg/L	0.094 R	0.02 U	0.02 UJ	0.044 U*	0.014	0.018	0.081	No
Metals/Inorganics (Unfiltered)									
Arsenic	mg/L	0.005 U	0.005 U	0.005 U	0.0059	0.003	0.004	0.050	No
Barium	mg/L	0.24	0.27	0.27	0.24	0.255	0.263	0.630	No
Chromium	mg/L	0.055	0.0091	0.005 U	0.005 U	0.017	0.030	0.743	No
Copper	mg/L	0.02	0.01 U	0.01 U	0.014 U*	0.009	0.013	0.031	No
Total Cyanide	mg/L	0.04 J	0.053	0.046	0.027 J	0.042	0.047	0.172	No
Zinc	mg/L	0.043 R	0.02 U	0.032 U*	0.021 U*	0.012	0.014	0.081	No

Notes:

U This compound was not detected at or above the associated numerical value. (Quantitation limit shown.)
U* This compound should be considered "not detected" since it was detected in a blank at a similar level. (Quantitation limit shown.)
J Quantitation is approximate due to limitations identified during the quality assurance review (data validation).
R Unusable result; compound may or may not be present in this sample.
UJ This compound was not detected, but the quantitation limit is probably higher due to a low bias identified during the quality assurance review. (Quantitation limit shown.)

Shaded values indicate constituent concentrations which exceed the preliminary site-specific action levels (PSALs).

R and UR flagged values are not included in the associated statistical calculations because these results are considered unusable.

(1) 80% UCL = Mean + [t-value for 0.80, n-1](Standard Deviation/n^0.5), where n=number of samples

TABLE 7-30

Detected Constituent Concentrations and PSAL Comparison for Groundwater Samples from Perimeter Monitoring Well RFIMW-2 BASF - Wyandotte RFI

		QUARTERLY SAMPLING EVENT				STATISTICAL VALUES			
CONSTITUENT	UNITS	1st Quarterly 9/26/96	2nd Quarterly 12/17/96	3rd Quarterly 3/19/97	4th Quarterly 6/2/97	MEAN	80% UCL (1)	PSAL	80% UCL Exceed PSAL?
Volatile Organics									
Acetone	ug/L	27 J	10 UR	10 UR	10 U*	16.000	31.136	25,000	No
Benzene	ug/L	1 UJ	1 U	0.28 J	0.77 J	0.513	0.611	53	No
Carbon disulfide	ug/L	0.59 J	1 U	0.12 J	0.14	0.338	0.456	1,600	No
Semi-Volatile Organics									
bis(2-Chloroethyl) ether	ug/L	45	37	26 J	24	33.00	37.81	10.00	Yes
1,4-Dioxane	ug/L	4 J	50 U	50 UR	50 U	18.00	25.43	2000.00	No
3-Methylphenol	ug/L	95 JN	55 JN	10 UR	18 JN	56.00	79.59	1800.00	No
4-Methylphenol	ug/L	95 JN	55 JN	10 UR	18 JN	56.00	79.59	10.00	Yes
Phenol	ug/L	5.3 J	5 U	5 UR	5 U	3.43	4.42	1100.00	No
Metals/Inorganics (Filtered)									
Arsenic	mg/L	0.005 U	0.0092	0.01 UJ	0.005 U	0.005	0.006	0.050	No
Barium	mg/L	0.53	0.4	0.36	0.48	0.443	0.480	0.630	No
Cadmium	mg/L	0.001 U	0.0011	0.0031	0.001 U	0.0013	0.0019	0.0008	Yes
Copper	mg/L	0.01 U	0.01 U	0.058 J	0.024 U*	0.020	0.032	0.031	Yes
Zinc	mg/L	0.031 U*	0.041	0.02 UJ	0.095 U*	0.029	0.038	0.081	No
Metals/Inorganics (Unfiltered)									
Arsenic	mg/L	0.044	0.0075	0.014 J	0.017	0.021	0.028	0.050	No
Barium	mg/L	0.77	0.53	0.44	0.48	0.555	0.627	0.630	No
Cadmium	mg/L	0.0068	0.001 U	0.002 U	0.0021	0.0026	0.0040	0.0008	Yes
Chromium	mg/L	0.18	0.03	0.069	0.041	0.080	0.114	0.743	No
Copper	mg/L	0.14	0.01 U	0.064 J	0.042 J	0.063	0.091	0.031	Yes
Lead	mg/L	0.046	0.003 UJ	0.006 UJ	0.01 J	0.015	0.025	0.010	Yes
Nickel	mg/L	0.17	0.04 U	0.044	0.051	0.071	0.104	0.238	No
Total Cyanide	mg/L	0.022 J	0.009	0.012	0.009 J	0.013	0.016	0.172	No
Vanadium	mg/L	0.13	0.02 U	0.024	0.03	0.049	0.075	0.027	Yes
Zinc	mg/L	0.31	0.054 U*	0.076	0.11 U*	0.117	0.181	0.081	Yes
Miscellaneous									
Acid-insoluble Sulfide	mg/L	2	1 U	1 UJ	1 U*	0.875	1.242	NA	NA

Notes:

- U This compound was not detected at or above the associated numerical value. (Quantitation limit shown.)
- U* This compound should be considered "not detected" since it was detected in a blank at a similar level. (Quantitation limit shown.)
- J Quantitation is approximate due to limitations identified during the quality assurance review (data validation).
- UJ This compound was not detected, but the quantitation limit is probably higher due to a low bias identified during the quality assurance review. (Quantitation limit shown.)
- UR Unusable "not detected" result; compound may or may not be present in this sample. (Quantitation limit shown.)
- JN Quantitation is approximate due to limitations identified during the quality assurance review (data validation). This result should be considered a tentative qualitative identification.
- NA Not Applicable

Shaded values indicate constituent concentrations which exceed the preliminary site-specific action levels (PSALs).

R and UR flagged values are not included in the associated statistical calculations because these results are considered unusable.

(1) 80% UCL = Mean + [t-value for 0.80, n-1](Standard Deviation/n^0.5), where n=number of samples

TABLE 7-31

Detected Constituent Concentrations and PSAL Comparison for Groundwater Samples from Perimeter Monitoring Well RFIMW-3
BASF - Wyandotte RFI

		QUARTERLY SAMPLING EVENT				STATISTICAL VALUES			
CONSTITUENT	UNITS	1st Quarterly 9/24/96	2nd Quarterly 12/18/96	3rd Quarterly 3/19/97	4th Quarterly 6/5/97	MEAN	80% UCL (1)	PSAL	80% UCL Exceed PSAL?
Volatile Organics									
Acetone	ug/L	22 J	17 J	10 UR	17 U*	15.83	20.01	25000.00	No
Carbon disulfide	ug/L	1 UJ	1 U	1 U	0.12 J	0.41	0.50	1600.00	No
Methyl ethyl ketone	ug/L	5.6 J	6.4 J	10 UR	10 UR	6.00	6.55	7200.00	No
Toluene	ug/L	1 UJ	1 U	0.31 J	0.16 J	0.37	0.45	110.00	No
Semi-Volatile Organics									
Acetophenone	ug/L	1.9 J	10 U	10 UR	10 U	3.97	5.06	3700.00	No
bis(2-Chloroethyl) ether	ug/L	12	14	6.4 J	15	11.85	13.73	10.00	Yes
3-Methylphenol	ug/L	8.9 JN	39 JN	7 JN	10 U	14.98	22.85	1800.00	No
4-Methylphenol	ug/L	8.9 JN	39 JN	7 JN	10 U	14.98	22.85	10.00	Yes
Phenol	ug/L	1.5 J	5 UR	5 UR	5 U	2.00	2.69	1100.00	No
Metals/Inorganics (Filtered)									
Arsenic	mg/L	0.005 U	0.005 U	0.014 J	0.011 J	0.008	0.010	0.050	No
Barium	mg/L	1.8 J	1.1	1.2	1.2	1.325	1.482	0.630	Yes
Zinc	mg/L	0.02 J	0.02 U	0.02 U*	0.051 U*	0.016	0.020	0.081	No
Metals/Inorganics (Unfiltered)									
Arsenic	mg/L	0.019	0.026	0.025 J	0.05 J	0.030	0.037	0.050	No
Barium	mg/L	1.4 J	1.7	1.2	1.7	1.500	1.620	0.630	Yes
Cadmium	mg/L	0.001 U	0.001 U	0.001 U	0.0033	0.0012	0.0019	0.0008	Yes
Chromium	mg/L	0.03	0.04	0.033	0.15 J	0.063	0.092	0.743	No
Copper	mg/L	0.032	0.04	0.048 U*	0.12	0.054	0.076	0.031	Yes
Lead	mg/L	0.016	0.021	0.021	0.071	0.032	0.045	0.010	Yes
Nickel	mg/L	0.053	0.062	0.047	0.18	0.086	0.116	0.238	No
Total Cyanide	mg/L	0.006 J	0.005 UJ	0.005 U	0.005 UJ	0.003	0.004	0.172	No
Vanadium	mg/L	0.035	0.042	0.043	0.13	0.063	0.085	0.027	Yes
Zinc	mg/L	0.091	0.11 U*	0.11 J	0.34	0.149	0.212	0.081	Yes

Notes:

- U This compound was not detected at or above the associated numerical value. (Quantitation limit shown.)
- U* This compound should be considered "not detected" since it was detected in a blank at a similar level. (Quantitation limit shown.)
- J Quantitation is approximate due to limitations identified during the quality assurance review (data validation).
- UJ This compound was not detected, but the quantitation limit is probably higher due to a low bias identified during the quality assurance review. (Quantitation limit shown.)
- UR Unusable "not detected" result; compound may or may not be present in this sample. (Quantitation limit shown.)
- JN Quantitation is approximate due to limitations identified during the quality assurance review (data validation). This result should be considered a tentative qualitative identification.

Shaded values indicate constituent concentrations which exceed the preliminary site-specific action levels (PSALs).

R and UR flagged values are not included in the associated statistical calculations because these results are considered unusable.

(1) 80% UCL = Mean + [t-value for 0.80, n-1](Standard Deviation/n^0.5), where n=number of samples

TABLE 7-32

Detected Constituent Concentrations and PSAL Comparison for Groundwater Samples from Perimeter Monitoring Well RFIMW-4
BASF - Wyandotte RFI

		QUARTERLY SAMPLING EVENT				STATISTICAL VALUES			
CONSTITUENT	UNITS	1st Quarterly 9/24/96	2nd Quarterly 12/18/96	3rd Quarterly 3/19/97	4th Quarterly 6/3/97	MEAN	80% UCL (1)	PSAL	80% UCL Exceed PSAL?
Volatile Organics									
Carbon disulfide	ug/L	1 UJ	1 U	0.1 J	0.2 J	0.33	0.43	1600.00	No
Semi-Volatile Organics									
1,4-Dioxane	ug/L	17 J	16 J	19 J	11 J	15.75	17.41	2000.00	No
Metals/Inorganics (Filtered)									
Arsenic	mg/L	0.52	0.25	0.17 J	0.36	0.325	0.399	0.050	Yes
Barium	mg/L	0.092 J	0.068	0.085	0.036	0.070	0.082	0.630	No
Metals/Inorganics (Unfiltered)									
Arsenic	mg/L	0.57	0.41	0.19 J	0.37	0.385	0.461	0.050	Yes
Barium	mg/L	0.081 J	0.078	0.1	0.036	0.074	0.087	0.630	No
Chromium	mg/L	0.015	0.0058	0.022	0.005 U	0.011	0.016	0.743	No
Copper	mg/L	0.018	0.01 U	0.017 U*	0.011 U*	0.009	0.012	0.031	No
Lead	mg/L	0.0039	0.003 UJ	0.0043	0.003 U	0.003	0.004	0.010	No
Total Cyanide	mg/L	0.13 J	0.057 J	0.064	0.017 J	0.067	0.090	0.172	No
Vanadium	mg/L	0.02 J	0.02 U	0.02 U	0.02 U	0.013	0.015	0.027	No
Zinc	mg/L	0.05	0.024 U*	0.052 J	0.038 U*	0.033	0.043	0.081	No
Miscellaneous									
Acid-insoluble Sulfide	mg/L	1	2	1 UJ	1 UJ	1.000	1.346	NA	NA

Notes:

U This compound was not detected at or above the associated numerical value. (Quantitation limit shown.)
U* This compound should be considered "not detected" since it was detected in a blank at a similar level. (Quantitation limit shown.)
J Quantitation is approximate due to limitations identified during the quality assurance review (data validation).
UJ This compound was not detected, but the quantitation limit is probably higher due to a low bias identified during the quality assurance review. (Quantitation limit shown.)
NA Not Applicable

Shaded values indicate constituent concentrations which exceed the preliminary site-specific action levels (PSALs).

R and UR flagged values are not included in the associated statistical calculations because these results are considered unusable.

(1) 80% UCL = Mean + [t-value for 0.80, n-1](Standard Deviation/n^0.5), where n=number of samples

TABLE 7-33

Detected Constituent Concentrations and PSAL Comparison for Groundwater Samples from Perimeter Monitoring Well RFIMW-5
BASF - Wyandotte RFI

CONSTITUENT	UNITS	QUARTERLY SAMPLING EVENT 1st Quarterly 9/24/96	2nd Quarterly 12/18/96	3rd Quarterly 3/20/97	4th Quarterly 6/3/97	STATISTICAL VALUES MEAN	80% UCL (1)	PSAL	80% UCL Exceed PSAL?
Volatile Organics									
Acetone	ug/L	140 J	86 J	69 J	78 U*	83.50	104.23	25000.00	No
Benzene	ug/L	1 UJ	0.68 J	0.59 J	0.45 J	0.56	0.60	53.00	No
1,2-Dichloropropane	ug/L	1.1 J	0.72 J	0.72 J	0.39 J	0.73	0.87	64.00	No
Methyl ethyl ketone	ug/L	9.8 J	10 U	9.1 J	9.9 J	8.45	9.59	7200.00	No
Toluene	ug/L	0.61 J	1 U	0.3 J	0.28 J	0.42	0.50	110.00	No
Semi-Volatile Organics									
bis(2-Chloroisopropyl) ether	ug/L	10 U	1.6 J	1.8 J	1.8 J	2.55	3.35	10.00	No
bis(2-Ethylhexyl) phthalate	ug/L	5 U	1.9 J	5 UR	3 J	2.47	2.80	59.00	No
2-Methylnaphthalene	ug/L	1.2 J	5 UR	5 UR	5 U	1.85	2.74	34.00	No
2-Methylphenol	ug/L	3.3 J	3.2 J	3.8 J	2.7 J	3.25	3.47	38.00	No
3-Methylphenol	ug/L	45 JN	29 JN	39 JN	29 JN	35.50	39.36	1800.00	No
4-Methylphenol	ug/L	45 JN	29 JN	39 JN	29 JN	35.50	39.36	10.00	Yes
Naphthalene	ug/L	3.9 J	2.9 J	3.7 J	2.9 J	3.35	3.61	34.00	No
Phenol	ug/L	41	14 J	28 J	22 U*	23.50	30.26	1100.00	No
Metals/Inorganics (Filtered)									
Barium	mg/L	1 J	1.2	1.2	0.97	1.093	1.153	0.630	Yes
Selenium	mg/L	0.0079	0.005 U	0.005 UJ	0.01	0.006	0.008	0.005	Yes
Metals/Inorganics (Unfiltered)									
Barium	mg/L	0.86 J	1.4	1.2	0.95	1.103	1.222	0.630	Yes
Chromium	mg/L	0.03	0.0066	0.005 U	0.005 U	0.010	0.017	0.743	No
Copper	mg/L	0.022	0.01 U	0.01 U	0.016 U*	0.010	0.014	0.031	No
Selenium	mg/L	0.0099	0.0061 U*	0.0054	0.0087	0.007	0.008	0.005	Yes
Total Cyanide	mg/L	0.005 UR	0.005 UJ	0.007	0.006 J	0.005	0.007	0.172	No
Zinc	mg/L	0.076	0.02 U	0.02 U	0.028 U*	0.028	0.043	0.081	No

Notes:

U This compound was not detected at or above the associated numerical value. (Quantitation limit shown.)
U* This compound should be considered "not detected" since it was detected in a blank at a similar level. (Quantitation limit shown.)
J Quantitation is approximate due to limitations identified during the quality assurance review (data validation).
UJ This compound was not detected, but the quantitation limit is probably higher due to a low bias identified during the quality assurance review. (Quantitation limit shown.)
UR Unusable "not detected" result; compound may or may not be present in this sample. (Quantitation limit shown.)
JN Quantitation is approximate due to limitations identified during the quality assurance review (data validation). This result should be considered a tentative qualitative identification.

Shaded values indicate constituent concentrations which exceed the preliminary site-specific action levels (PSALs).

R and UR flagged values are not included in the associated statistical calculations because these results are considered unusable.

(1) 80% UCL = Mean + [t-value for 0.80, n-1](Standard Deviation/n^0.5), where n=number of samples

TABLE 7-34

Detected Constituent Concentrations and PSAL Comparison for Groundwater Samples from Perimeter Monitoring Well RFIMW-6
BASF - Wyandotte RFI

CONSTITUENT	UNITS	QUARTERLY SAMPLING EVENT 1st Quarterly 9/24/96	2nd Quarterly 12/18/96	3rd Quarterly 3/20/97	4th Quarterly 6/3/97	STATISTICAL VALUES MEAN	80% UCL (1)	PSAL	80% UCL Exceed PSAL?
Volatile Organics									
Acetone	ug/L	19 J	10 UR	14 J	10 U*	12.67	17.01	25000.00	No
Carbon disulfide	ug/L	1 UJ	1 U	0.32 J	1 UJ	0.46	0.50	1600.00	No
1,2-Dichloroethane	ug/L	1 UJ	1 U	0.58 J	0.47 J	0.51	0.54	560.00	No
1,2-Dichloropropane	ug/L	32 J	35	27	22 J	29.00	31.79	64.00	No
Toluene	ug/L	1 UJ	1 U	0.2 J	0.16 J	0.34	0.43	110.00	No
Semi-Volatile Organics									
bis(2-Chloroisopropyl) ether	ug/L	18	14 J	18 J	15	16.25	17.26	10.00	Yes
3-Methylphenol	ug/L	5.5 JN	11 JN	10 JN	8.6 JN	8.78	9.95	1800.00	No
4-Methylphenol	ug/L	5.5 JN	11 JN	10 JN	8.6 JN	8.78	9.95	10.00	No
Naphthalene	ug/L	1.6 J	1.3 J	5 UR	1.5 J	1.47	1.56	34.00	No
Phenanthrene	ug/L	1.4 J	5 UJ	5 UR	5 U	2.13	2.52	5.00	No
Phenol	ug/L	13	14 J	10 J	12 U*	10.75	12.51	1100.00	No
Metals/Inorganics (Filtered)									
Barium	mg/L	0.12	0.11	0.1	0.088	0.105	0.111	0.630	No
Mercury	mg/L	0.00031	0.0002 U*	0.0002 U	0.0002 U	0.0002	0.0002	0.0001	Yes
Selenium	mg/L	0.0061 J	0.0076 U*	0.005 U	0.005 U	0.004	0.005	0.005	No
Zinc	mg/L	0.02 U	0.062	0.02 U	0.02 U	0.023	0.036	0.081	No
Metals/Inorganics (Unfiltered)									
Arsenic	mg/L	0.0075 J	0.0056	0.005 UJ	0.005 U	0.005	0.006	0.050	No
Barium	mg/L	0.13	0.12	0.11	0.092	0.113	0.121	0.630	No
Chromium	mg/L	0.033	0.016	0.011	0.012 J	0.018	0.023	0.743	No
Copper	mg/L	0.022	0.013 J	0.01 U	0.011 U*	0.011	0.015	0.031	No
Lead	mg/L	0.0079	0.0058 U*	0.003 U	0.003 U	0.003	0.005	0.010	No
Mercury	mg/L	0.00099	0.00053 U*	0.00038	0.00026	0.0005	0.0006	0.0001	Yes
Selenium	mg/L	0.006 J	0.005 U	0.005 UJ	0.005 U	0.003	0.004	0.005	No
Total Cyanide	mg/L	0.012 J	0.007 J	0.012	0.03 J	0.015	0.020	0.172	No
Zinc	mg/L	0.077	0.067 U*	0.029 U*	0.042 U*	0.037	0.050	0.081	No

Notes:

- U This compound was not detected at or above the associated numerical value. (Quantitation limit shown.)
- U* This compound should be considered "not detected" since it was detected in a blank at a similar level. (Quantitation limit shown.)
- J Quantitation is approximate due to limitations identified during the quality assurance review (data validation).
- UJ This compound was not detected, but the quantitation limit is probably higher due to a low bias identified during the quality assurance review. (Quantitation limit shown.)
- UR Unusable "not detected" result; compound may or may not be present in this sample. (Quantitation limit shown.)
- JN Quantitation is approximate due to limitations identified during the quality assurance review (data validation). This result should be considered a tentative qualitative identification.

Shaded values indicate constituent concentrations which exceed the preliminary site-specific action levels (PSALs).

R and UR flagged values are not included in the associated statistical calculations because these results are considered unusable.

(1) 80% UCL = Mean + [t-value for 0.80, n-1](Standard Deviation/n^0.5), where n=number of samples

TABLE 7-35

Detected Constituent Concentrations and PSAL Comparison for Groundwater Samples from Perimeter Monitoring Well RFIMW-7
BASF - Wyandotte RFI

CONSTITUENT	UNITS	QUARTERLY SAMPLING EVENT						STATISTICAL VALUES			
		1st Quarterly 9/23/96	2nd Quarterly 12/18/96	3rd Quarterly 3/20/97	3rd Quarterly (MW-30)	4th Quarterly 6/3/97	4th Quarterly (MW-30)	MEAN	80% UCL (1)	PSAL	80% UCL Exceed PSAL?
Volatile Organics											
Acetone	ug/L	57 J	100 J	130 J	86 J	80 U*	55 U*	74.69	91.95	25000.00	No
Benzene	ug/L	2.5 UJ	2.5 U	0.64 J	0.41 J	5 UJ	0.39 J	1.12	1.32	53.00	No
1,1-Dichloroethane	ug/L	3.6 J	12	15	8.9	7.5 J	5.8 J	8.55	10.58	1000.00	No
1,1-Dichloroethene	ug/L	2.5 UJ	3.5	2.1 J	1.2 J	1.6 J	0.88 J	1.91	2.44	32.00	No
Ethylbenzene	ug/L	4.5 J	19	27	20	16 J	11 J	15.13	19.12	31.00	No
m-Xylene & p-Xylene	ug/L	6.9 J	30	45	36	30 J	19	25.48	32.35	59.00	No
Methyl ethyl ketone	ug/L	9 J	22	50 UR	21 J	50 UR	25 UR	17.33	21.76	7200.00	No
o-Xylene	ug/L	3.6 J	14	20	17	13 J	8.2 J	11.68	14.75	59.00	No
Toluene	ug/L	2.5 UJ	2.1 J	3.4 J	2.4 J	1.9 J	1.2 J	1.95	2.30	110.00	No
1,1,1-Trichloroethane	ug/L	7.1 J	69	84	40	36 J	22 J	41.78	55.94	120.00	No
Semi-Volatile Organics											
Acenaphthene	ug/L	25 U	10 UJ	3 J	2.6 J	2.2 J	3.2 J	5.75	8.01	5.00	Yes
bis(2-Ethylhexyl) phthalate	ug/L	13 J	10 UJ	10 UR	10 UR	10 U	10 U	7.67	10.50	59.00	No
Dibenzofuran	ug/L	25 U	10 UJ	2.9 J	3 J	2.6 J	3 J	5.81	8.05	150.00	No
1,4-Dioxane	ug/L	24 J	44 J	34 J	27 J	24 J	36 J	32.13	36.26	2000.00	No
2-Methylnaphthalene	ug/L	42	82 J	110 J	110 J	110	110	86.00	101.73	34.00	Yes
2-Methylphenol	ug/L	11 J	4.2 J	10 UR	2.6 J	10 U	3.5 J	5.51	7.34	38.00	No
3-Methylphenol	ug/L	63 JN	18 JN	6.4 JN	11 JN	9.2 JN	15 JN	25.45	37.83	1800.00	No
4-Methylphenol	ug/L	63 JN	18 JN	6.4 JN	11 JN	9.2 JN	15 JN	25.45	37.83	10.00	Yes
Naphthalene	ug/L	34	54 J	67 J	64 J	63	67	54.63	61.83	34.00	Yes
Phenanthrene	ug/L	25 U	2.2 J	3 J	3.1 J	10 U	3 J	5.44	7.77	5.00	Yes
Phenol	ug/L	310	100 J	41 J	50 J	58 U*	98 U*	123.63	185.84	1100.00	No
Metals/Inorganics (Filtered)											
Barium	mg/L	0.12	0.11	0.086	0.087	0.087	0.09	0.101	0.109	0.630	No
Chromium	mg/L	0.0074	0.0088	0.031	0.032	0.024	0.014 J	0.017	0.022	0.743	No
Copper	mg/L	0.021	0.01 U	0.01 U	0.01 U	0.016 U*	0.014 U*	0.010	0.013	0.031	No
Mercury	mg/L	0.00026	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0001	0.0002	0.0001	Yes
Selenium	mg/L	0.018	0.018 U*	0.027	0.027 J	0.023	0.02	0.019	0.023	0.005	Yes
Metals/Inorganics (Unfiltered)											
Arsenic	mg/L	0.0096 J	0.0073	0.005 UJ	0.005 UJ	0.005 U	0.005 UJ	0.005	0.007	0.050	No
Barium	mg/L	0.13	0.13	0.091	0.085	0.089	0.088	0.109	0.121	0.630	No
Chromium	mg/L	0.063	0.035	0.023	0.061	0.022	0.033 J	0.042	0.049	0.743	No
Copper	mg/L	0.032	0.02 J	0.01 U	0.012 U*	0.02 U*	0.018 U*	0.017	0.023	0.031	No
Lead	mg/L	0.0039	0.0038 U*	0.003 U	0.003 U	0.003 U	0.003 U	0.002	0.003	0.010	No
Nickel	mg/L	0.041	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.025	0.030	0.238'	No
Selenium	mg/L	0.016	0.021	0.016 J	0.025 J	0.023	0.017	0.019	0.020	0.005	Yes
Total Cyanide	mg/L	0.13 J	0.041 J	0.047	0.052	0.065 J	0.052 J	0.070	0.090	0.172	No
Zinc	mg/L	0.047 J	0.11 U*	0.032 U*	0.02 U	0.039 U*	0.092 U*	0.037	0.046	0.081	No

Notes:

U This compound was not detected at or above the associated numerical value. (Quantitation limit shown.)
U* This compound should be considered "not detected" since it was detected in a blank at a similar level. (Quantitation limit shown.)
J Quantitation is approximate due to limitations identified during the quality assurance review (data validation).
UJ This compound was not detected, but the quantitation limit is probably higher due to a low bias identified during the quality assurance review. (Quantitation limit shown.)
UR Unusable "not detected" result; compound may or may not be present in this sample. (Quantitation limit shown.)
JN Quantitation is approximate due to limitations identified during the quality assurance review (data validation). This result should be considered a tentative qualitative identification.

Shaded values indicate constituent concentrations which exceed the preliminary site-specific action levels (PSALs).

R and UR flagged values are not included in the associated statistical calculations because these results are considered unusable.

(1) 80% UCL = Mean + [t-value for 0.80, n-1](Standard Deviation/n^0.5), where n=number of samples

TABLE 7-36

Detected Constituent Concentrations and PSAL Comparison for Groundwater Samples from Perimeter Monitoring Well RFIMW-8
BASF - Wyandotte RFI

CONSTITUENT	UNITS	QUARTERLY SAMPLING EVENT 1st Quarterly 9/23/96	2nd Quarterly 12/18/96	3rd Quarterly 3/24/97	4th Quarterly 6/3/97	STATISTICAL VALUES MEAN	80% UCL (1)	PSAL	80% UCL Exceed PSAL?
Volatile Organics									
Carbon disulfide	ug/L	1.1	1 U	0.15 J	1 UJ	0.56	0.76	1600.00	No
Chloroform	ug/L	12	1 U	1 U	1 UJ	3.38	6.19	80.00	No
Semi-Volatile Organics									
bis(2-Ethylhexyl) phthalate	ug/L	5 U	5 UJ	1.8 J	5 U	2.33	2.50	59.00	No
Phenol	ug/L	4.8 J	5 UJ	5 U	5 U	3.08	3.64	1100.00	No
Metals/Inorganics (Filtered)									
Barium	mg/L	0.56 R	0.96	0.98	0.99	0.977	0.986	0.630	Yes
Cadmium	mg/L	0.0011	0.001 U	0.001 U	0.001 U	0.0007	0.0008	0.0008	No
Chromium	mg/L	0.0063	0.005 U	0.005 U	0.005 U	0.003	0.004	0.743	No
Zinc	mg/L	0.064	0.033	0.021 U*	0.02 U	0.029	0.042	0.081	No
Metals/Inorganics (Unfiltered)									
Barium	mg/L	0.35 R	0.87	1.1	1	0.990	1.061	0.630	Yes
Cadmium	mg/L	0.0012	0.001 U	0.001 U	0.001 U	0.0007	0.0008	0.0008	Yes
Chromium	mg/L	0.032	0.005 U	0.005 U	0.005 U	0.010	0.017	0.743	No
Copper	mg/L	0.033	0.01 U	0.01 U	0.014 U*	0.013	0.019	0.031	No
Lead	mg/L	0.0036	0.003 UJ	0.003 U	0.003 U	0.002	0.003	0.010	No
Total Cyanide	mg/L	0.005 UR	0.005 UJ	0.005 U	0.01 J	0.005	0.008	0.172	No
Zinc	mg/L	0.24	0.039 U*	0.027 U*	0.068 U*	0.077	0.130	0.081	Yes

Notes:

U This compound was not detected at or above the associated numerical value. (Quantitation limit shown.)
U* This compound should be considered "not detected" since it was detected in a blank at a similar level. (Quantitation limit shown.)
J Quantitation is approximate due to limitations identified during the quality assurance review (data validation).
R Unusable result; compound may or may not be present in this sample.
UJ This compound was not detected, but the quantitation limit is probably higher due to a low bias identified during the quality assurance review. (Quantitation limit shown.)
UR Unusable "not detected" result; compound may or may not be present in this sample. (Quantitation limit shown.)

Shaded values indicate constituent concentrations which exceed the preliminary site-specific action levels (PSALs).

R and UR flagged values are not included in the associated statistical calculations because these results are considered unusable.

(1) 80% UCL = Mean + [t-value for 0.80, n-1](Standard Deviation/n^0.5), where n=number of samples

TABLE 7-37

Detected Constituent Concentrations and PSAL Comparison for Groundwater Samples from Perimeter Monitoring Well RFIMW-9
BASF - Wyandotte RFI

		QUARTERLY SAMPLING EVENT				STATISTICAL VALUES			
CONSTITUENT	UNITS	1st Quarterly 9/23/96	2nd Quarterly 12/18/96	3rd Quarterly 3/24/97	4th Quarterly 6/4/97	MEAN	80% UCL (1)	PSAL	80% UCL Exceed PSAL?
Volatile Organics									
Acetone	ug/L	8.5 J	10 UR	10 UR	10 UR	8.50	8.50	25000.00	No
Carbon disulfide	ug/L	0.51 J	1 U	1 U	1 UJ	0.50	0.50	1600.00	No
Chloroform	ug/L	5.1	1 U	1 U	1 U	1.65	2.77	80.00	No
Semi-Volatile Organics									
bis(2-Ethylhexyl) phthalate	ug/L	5 U	5 UJ	5 U	2.4 J	2.48	2.50	59.00	No
Phenol	ug/L	5.6	5 UJ	5 U	5 U	3.28	4.03	1100.00	No
Metals/Inorganics (Filtered)									
Arsenic	mg/L	0.005 U	0.023	0.025 J	0.026	0.019	0.025	0.050	No
Barium	mg/L	0.17 J	0.21	0.22	0.21	0.203	0.213	0.630	No
Chromium	mg/L	0.024	0.005 U	0.005 U	0.005 U	0.008	0.013	0.743	No
Zinc	mg/L	0.25	0.02 U	0.02 U	0.034 U*	0.072	0.130	0.081	Yes
Metals/Inorganics (Unfiltered)									
Arsenic	mg/L	0.005 U	0.025	0.025 J	0.025	0.019	0.025	0.050	No
Barium	mg/L	0.15 J	0.22	0.21	0.2	0.195	0.210	0.630	No
Cadmium	mg/L	0.0045	0.001 U	0.001 U	0.001 U	0.0015	0.0025	0.0008	Yes
Chromium	mg/L	0.082	0.005 U	0.005 U	0.005 U	0.022	0.042	0.743	No
Copper	mg/L	0.024	0.01 U	0.01 U	0.016 U*	0.011	0.015	0.031	No
Nickel	mg/L	0.064	0.04 U	0.04 U	0.04 U	0.031	0.042	0.238	No
Total Cyanide	mg/L	0.005 UR	0.005 UJ	0.005 U	0.01 J	0.005	0.008	0.172	No
Zinc	mg/L	0.3	0.028 U*	0.03 U*	0.056 U*	0.089	0.158	0.081	Yes

Notes:

U This compound was not detected at or above the associated numerical value. (Quantitation limit shown.)
U* This compound should be considered "not detected" since it was detected in a blank at a similar level. (Quantitation limit shown.)
J Quantitation is approximate due to limitations identified during the quality assurance review (data validation).
UJ This compound was not detected, but the quantitation limit is probably higher due to a low bias identified during the quality assurance review. (Quantitation limit shown.)
UR Unusable "not detected" result; compound may or may not be present in this sample. (Quantitation limit shown.)

Shaded values indicate constituent concentrations which exceed the preliminary site-specific action levels (PSALs).

R and UR flagged values are not included in the associated statistical calculations because these results are considered unusable.

(1) 80% UCL = Mean + [t-value for 0.80, n-1](Standard Deviation/n^0.5), where n=number of samples

TABLE 7-38

Detected Constituent Concentrations and PSAL Comparison for Groundwater Samples from Perimeter Monitoring Well RFIMW-10
BASF - Wyandotte RFI

		QUARTERLY SAMPLING EVENT					STATISTICAL VALUES			
CONSTITUENT	UNITS	1st Quarterly 9/18/96	2nd Quarterly 12/19/96 (10D)	2nd Quarterly [10 (MS/MSD)]	3rd Quarterly 3/20/97	4th Quarterly 6/4/97	MEAN	80% UCL (1)	PSAL	80% UCL Exceed PSAL?
Semi-Volatile Organics										
bis(2-Ethylhexyl) phthalate	ug/L	5 U	5 U	1.5 J	5.000 UR	5 U	2.33	2.51	59.00	No
Metals/Inorganics (Filtered)										
Arsenic	mg/L	0.019	0.015	0.015	0.013 J	0.016	0.016	0.017	0.050	No
Barium	mg/L	0.86	0.65	0.65	0.720	0.81	0.760	0.806	0.630	Yes
Zinc	mg/L	0.045 U*	0.026	0.02 U	0.020 U	0.02 U	0.015	0.018	0.081	No
Metals/Inorganics (Unfiltered)										
Arsenic	mg/L	0.019	0.017	0.016	0.015 J	0.015	0.016	0.017	0.050	No
Barium	mg/L	0.84	0.75	0.75	0.860	0.79	0.810	0.834	0.630	Yes
Chromium	mg/L	0.014	0.005 U	0.005 U	0.005 U	0.005 U	0.005	0.008	0.743	No
Total Cyanide	mg/L	0.005 UJ	0.005	0.005 U	0.005	0.01 J	0.005	0.007	0.172	No

Notes:

U This compound was not detected at or above the associated numerical value. (Quantitation limit shown.)
U* This compound should be considered "not detected" since it was detected in a blank at a similar level. (Quantitation limit shown.)
J Quantitation is approximate due to limitations identified during the quality assurance review (data validation).
UJ This compound was not detected, but the quantitation limit is probably higher due to a low bias identified during the quality assurance review. (Quantitation limit shown.)
UR Unusable "not detected" result; compound may or may not be present in this sample. (Quantitation limit shown.)

Shaded values indicate constituent concentrations which exceed the preliminary site-specific action levels (PSALs).

R and UR flagged values are not included in the associated statistical calculations because these results are considered unusable.

(1) 80% UCL = Mean + [t-value for 0.80, n-1](Standard Deviation/n^0.5), where n=number of samples

TABLE 7-39

Detected Constituent Concentrations and PSAL Comparison for Groundwater Samples from Perimeter Monitoring Well RFIMW-11
BASF - Wyandotte RFI

		QUARTERLY SAMPLING EVENT				STATISTICAL VALUES			
CONSTITUENT	UNITS	1st Quarterly 9/18/96	2nd Quarterly 12/19/96	3rd Quarterly 3/21/97	4th Quarterly 6/4/97	MEAN	80% UCL (1)	PSAL	80% UCL Exceed PSAL?
Semi-Volatile Organics									
bis(2-Ethylhexyl) phthalate	ug/L	2.8 J	5 UR	5 UR	3.5 J	3.15	3.63	59.00	No
Metals/Inorganics (Filtered)									
Arsenic	mg/L	0.012	0.014	0.0063 J	0.013 J	0.011	0.013	0.050	No
Barium	mg/L	0.11	0.11	0.096	0.12	0.109	0.114	0.630	No
Zinc	mg/L	0.02 U	0.024	0.02 U	0.04 U*	0.016	0.019	0.081	No
Metals/Inorganics (Unfiltered)									
Antimony	mg/L	0.01	0.0085	0.005 U	0.0087 U*	0.006	0.008	0.050	No
Arsenic	mg/L	0.14	0.11	0.017 J	0.12 J	0.097	0.123	0.050	Yes
Barium	mg/L	0.34	0.28	0.1	0.28	0.250	0.301	0.630	No
Cadmium	mg/L	0.0043	0.0028	0.001 U	0.004	0.0029	0.0037	0.0008	Yes
Chromium	mg/L	0.11	0.087	0.019	0.1 J	0.079	0.099	0.743	No
Copper	mg/L	0.42	0.32	0.041 U*	0.37	0.283	0.370	0.031	Yes
Lead	mg/L	0.22	0.19	0.019	0.22	0.162	0.209	0.010	Yes
Mercury	mg/L	0.0054	0.0053	0.00069	0.0056	0.0042	0.0054	0.0001	Yes
Nickel	mg/L	0.13	0.1	0.04 U	0.13	0.095	0.120	0.238	No
Total Cyanide	mg/L	0.052 J	0.036	0.012	0.009 J	0.027	0.037	0.172	No
Vanadium	mg/L	0.079	0.072	0.02 U	0.073	0.059	0.074	0.027	Yes
Zinc	mg/L	0.6	0.49	0.069	0.53 U*	0.356	0.472	0.081	Yes

Notes:

U This compound was not detected at or above the associated numerical value. (Quantitation limit shown.)
U* This compound should be considered "not detected" since it was detected in a blank at a similar level. (Quantitation limit shown.)
J Quantitation is approximate due to limitations identified during the quality assurance review (data validation).
UJ This compound was not detected, but the quantitation limit is probably higher due to a low bias identified during the quality assurance review. (Quantitation limit shown.)
UR Unusable "not detected" result; compound may or may not be present in this sample. (Quantitation limit shown.)

Shaded values indicate constituent concentrations which exceed the preliminary site-specific action levels (PSALs).

R and UR flagged values are not included in the associated statistical calculations because these results are considered unusable.

(1) 80% UCL = Mean + [t-value for 0.80, n-1](Standard Deviation/n^0.5), where n=number of samples

TABLE 7-40

Detected Constituent Concentrations and PSAL Comparison for Groundwater Samples from Perimeter Monitoring Well RFIMW-12
BASF - Wyandotte RFI

		QUARTERLY SAMPLING EVENT				STATISTICAL VALUES			
CONSTITUENT	UNITS	1st Quarterly 9/18/96	2nd Quarterly 12/19/96	3rd Quarterly 3/21/97	4th Quarterly 6/4/97	MEAN	80% UCL (1)	PSAL	80% UCL Exceed PSAL?
Volatile Organics									
Acetone	ug/L	230 J	150 J	130 J	250 UR	170.00	202.41	25000.00	No
Benzene	ug/L	5 UJ	2.5 UJ	0.31 J	25 U	4.14	6.90	53.00	No
Carbon disulfide	ug/L	5 UJ	2.2	4.1	3 J	2.95	3.36	1600.00	No
Methyl ethyl ketone	ug/L	50 UJ	21 J	22 J	250 UR	22.67	23.94	7200.00	No
Toluene	ug/L	5 UJ	2.5 UJ	0.34 J	25 U	4.15	6.90	110.00	No
Semi-Volatile Organics									
3-Methylphenol	ug/L	210 JN	89 JN	120 JN	84 JN	125.75	154.30	1800.00	No
4-Methylphenol	ug/L	210 JN	89 JN	120 JN	84 JN	125.75	154.30	10.00	Yes
Phenol	ug/L	1100	940	790 J	690 U*	793.75	952.60	1100.00	No
Metals/Inorganics (Filtered)									
Arsenic	mg/L	0.47	0.25	0.29 J	0.33 J	0.335	0.382	0.050	Yes
Barium	mg/L	0.025	0.024	0.039	0.027	0.029	0.032	0.630	No
Chromium	mg/L	0.063	0.052	0.04	0.059 J	0.054	0.058	0.743	No
Copper	mg/L	0.011	0.01 U	0.01 U	0.013 U*	0.007	0.008	0.031	No
Mercury	mg/L	0.008 J	0.003	0.0031	0.0033	0.0044	0.0055	0.0001	Yes
Nickel	mg/L	0.31	0.19	0.17	0.21	0.220	0.250	0.238	Yes
Selenium	mg/L	0.011	0.013 U*	0.005 U	0.0052	0.006	0.008	0.005	Yes
Vanadium	mg/L	0.4	0.25	0.28	0.31	0.310	0.342	0.027	Yes
Zinc	mg/L	0.038 U*	0.046	0.021 U*	0.12 U*	0.034	0.045	0.081	No
Metals/Inorganics (Unfiltered)									
Arsenic	mg/L	0.45	0.24	0.36 J	0.41 J	0.365	0.410	0.050	Yes
Barium	mg/L	0.11	0.15	0.048	0.043	0.088	0.113	0.630	No
Cadmium	mg/L	0.001 U	0.0013	0.001 U	0.001 U	0.0007	0.0009	0.0008	Yes
Chromium	mg/L	0.091	0.074	0.059	0.069 J	0.073	0.080	0.743	No
Copper	mg/L	0.048	0.032	0.01 U*	0.02 U*	0.024	0.034	0.031	Yes
Lead	mg/L	0.018	0.015	0.003 U	0.003 U	0.009	0.013	0.010	Yes
Mercury	mg/L	0.0069 J	0.0028	0.0041	0.0039	0.0044	0.0053	0.0001	Yes
Nickel	mg/L	0.31	0.2	0.22	0.24	0.243	0.266	0.238	Yes
Selenium	mg/L	0.0098	0.0088 U*	0.0073	0.0069	0.007	0.008	0.005	Yes
Total Cyanide	mg/L	1.8 J	1.4	0.49	0.006 J	0.924	1.326	0.172	Yes
Vanadium	mg/L	0.4	0.25	0.36	0.38	0.348	0.380	0.027	Yes
Zinc	mg/L	0.15	0.12 U*	0.034 U*	0.078 U*	0.067	0.095	0.081	Yes
Miscellaneous									
Acid-insoluble Sulfide	mg/L	2 J	8	8	9 U*	5.625	7.056	NA	NA

Notes:

- U This compound was not detected at or above the associated numerical value. (Quantitation limit shown.)
- U* This compound should be considered "not detected" since it was detected in a blank at a similar level. (Quantitation limit shown.)
- J Quantitation is approximate due to limitations identified during the quality assurance review (data validation).
- UJ This compound was not detected, but the quantitation limit is probably higher due to a low bias identified during the quality assurance review. (Quantitation limit shown.)
- UR Unusable "not detected" result; compound may or may not be present in this sample. (Quantitation limit shown.)
- JN Quantitation is approximate due to limitations identified during the quality assurance review (data validation). This result should be considered a tentative qualitative identification.
- NA Not Applicable

Shaded values indicate constituent concentrations which exceed the preliminary site-specific action levels (PSALs).

R and UR flagged values are not included in the associated statistical calculations because these results are considered unusable.

(1) 80% UCL = Mean + [t-value for 0.80, n-1](Standard Deviation/n^0.5), where n=number of samples

TABLE 7-41

Detected Constituent Concentrations and PSAL Comparison for Groundwater Samples from Perimeter Monitoring Well RFIMW-22
BASF - Wyandotte RFI

		QUARTERLY SAMPLING EVENT				STATISTICAL VALUES			
CONSTITUENT	UNITS	1st Quarterly 9/27/96	2nd Quarterly 12/19/96	3rd Quarterly 3/17/97	4th Quarterly 6/2/97	MEAN	80% UCL (1)	PSAL	80% UCL Exceed PSAL?
Volatile Organics									
Acetone	ug/L	14000 J	12000 J	13000 J	11000 U*	11125.00	13001.71	25000.00	No
Benzene	ug/L	2900 J	2800 J	2800 J	2500 J	2750.00	2834.70	53.00	Yes
Chlorobenzene	ug/L	75 J	170 UR	54 J	49 J	59.33	67.78	26.00	Yes
Toluene	ug/L	100 J	97 J	98 J	88 J	95.75	98.35	110.00	No
Vinyl chloride	ug/L	230 J	230 J	210 J	200 J	217.50	224.84	3.10	Yes
Semi-Volatile Organics									
bis(2-Chloroethyl) ether	ug/L	120 J	37 J	110 J	87 J	88.50	106.60	10.00	Yes
1,4-Dioxane	ug/L	110 J	56 J	1000 UR	3000 U	555.33	1056.75	2000.00	No
o-Toluidine	ug/L	500 U	200 U	86 J	600 U	184.00	236.42	10.00	Yes
Phenol	ug/L	250 U	100 U	260 J	300 U	146.25	188.76	1100.00	No
Pyridine	ug/L	500 U	200 U	41 J	600 U	172.75	232.51	20.00	Yes
Metals/Inorganics (Filtered)									
Arsenic	mg/L	0.35	0.29	0.33 J	0.33	0.325	0.337	0.050	Yes
Barium	mg/L	0.13	0.11	0.14	0.14	0.130	0.137	0.630	No
Chromium	mg/L	0.096	0.078	0.091	0.1	0.091	0.096	0.743	No
Copper	mg/L	0.037	0.019	0.035 U*	0.038	0.028	0.033	0.031	Yes
Lead	mg/L	0.0058	0.003 U*	0.005	0.0046	0.004	0.005	0.010	No
Nickel	mg/L	0.099	0.089	0.1	0.11	0.100	0.104	0.238	No
Selenium	mg/L	0.0087	0.0097 U*	0.011	0.011	0.009	0.010	0.005	Yes
Vanadium	mg/L	1.1	0.93	1.1	1.1	1.058	1.099	0.027	Yes
Zinc	mg/L	0.069	0.024	0.039 U*	0.064 U*	0.036	0.047	0.081	No
Metals/Inorganics (Unfiltered)									
Arsenic	mg/L	0.32	0.27	0.34 J	0.31	0.310	0.324	0.050	Yes
Barium	mg/L	0.16	0.12	0.16	0.14	0.145	0.154	0.630	No
Chromium	mg/L	0.12	0.083	0.096	0.093	0.098	0.106	0.743	No
Copper	mg/L	0.04	0.021	0.043 U*	0.036 U*	0.025	0.030	0.031	No
Lead	mg/L	0.012	0.0055 U*	0.0088	0.0054	0.007	0.009	0.010	No
Nickel	mg/L	0.13	0.079	0.11	0.1	0.105	0.115	0.238	No
Selenium	mg/L	0.0092	0.011 U*	0.0096	0.011	0.009	0.010	0.005	Yes
Total Cyanide	mg/L	46 J	41	39	39 J	41.250	42.866	0.172	Yes
Vanadium	mg/L	1	0.82	1.2	1	1.005	1.081	0.027	Yes
Zinc	mg/L	0.075	0.033 U*	0.059 J	0.069 U*	0.046	0.059	0.081	No
Miscellaneous									
2,4,5-TP (Silvex)	ug/L	25 U	25 U	2 U	0.86 J	6.72	9.98	21.00	No
Acid-insoluble Sulfide	mg/L	5	3	3 J	1 UJ	2.88	3.78	NA	NA

Notes:

- U This compound was not detected at or above the associated numerical value. (Quantitation limit shown.)
- U* This compound should be considered "not detected" since it was detected in a blank at a similar level. (Quantitation limit shown.)
- J Quantitation is approximate due to limitations identified during the quality assurance review (data validation).
- UJ This compound was not detected, but the quantitation limit is probably higher due to a low bias identified during the quality assurance review (Quantitation limit shown.)
- UR Unusable "not detected" result; compound may or may not be present in this sample (Quantitation limit shown.)
- NA Not Applicable

Shaded values indicate constituent concentrations which exceed the preliminary site-specific action levels (PSALs).

R and UR flagged values are not included in the associated statistical calculations because these results are considered unusable.

(1) 80% UCL = Mean + [t-value for 0.80, n-1](Standard Deviation/n^0.5), where n=number of samples

TABLE 7-42

Detected Constituent Concentrations and PSAL Comparison for Groundwater Samples from Perimeter Monitoring Well RFIMW-23
BASF - Wyandotte RFI

CONSTITUENT	UNITS	QUARTERLY SAMPLING EVENT 1st Quarterly 9/30/96	2nd Quarterly 12/19/96	3rd Quarterly 3/19/97	4th Quarterly 6/5/97	STATISTICAL VALUES MEAN	80% UCL (1)	PSAL	80% UCL Exceed PSAL?
Volatile Organics									
Benzene	ug/L	1 UJ	1 U	1 U	0.12 J	0.41	0.50	53.00	No
Chlorobenzene	ug/L	1 UJ	0.78 J	0.48 J	0.47 J	0.56	0.63	26.00	No
Styrene	ug/L	1 UJ	1 U	0.12 J	1 UJ	0.41	0.50	19.00	No
Semi-Volatile Organics									
Acenaphthylene	ug/L	2.6 J	5 U	1.1 J	1.9 J	2.03	2.36	5.00	No
Acetophenone	ug/L	2.2 J	10 U	10 UR	10 U	4.07	5.06	3700.00	No
Anthracene	ug/L	3.4 J	5 U	5 UR	5 U	2.80	3.12	110000.00	No
Benzo(a)anthracene	ug/L	15	1.9 J	6.7 J	9.4	8.25	10.92	5.00	Yes
Benzo(a)pyrene	ug/L	10	5 U	4.8 J	6.1	5.85	7.39	5.00	Yes
Benzo(b)fluoranthene	ug/L	12	1.9 J	5.7 J	7.4	6.75	8.80	5.00	Yes
Benzo(ghi)perylene	ug/L	4.8 J	5 U	2.5 J	3.1 J	3.23	3.76	5.00	No
Benzo(k)fluoranthene	ug/L	6.4	5 U	2.8 J	4 J	3.93	4.79	5.00	No
bis(2-Ethylhexyl) phthalate	ug/L	5 U	1.4 J	5 UR	5 U	2.13	2.52	59.00	No
Chrysene	ug/L	10	1.8 J	5.2 J	8.2	6.30	8.06	5.00	Yes
Dibenz(a,h)anthracene	ug/L	1.8 J	5 U	5 UR	1 J	1.77	2.23	5.00	No
Fluoranthene	ug/L	44	13	24 J	28	27.25	33.53	370.00	No
Indeno(1,2,3-cd)pyrene	ug/L	5.5	5 U	2.8 J	3.8 J	3.65	4.31	5.00	No
Pyrene	ug/L	30 J	10	18 J	23	20.25	24.37	11000.00	No
Metals/Inorganics (Filtered)									
Arsenic	mg/L	0.013	0.0062	0.0069 J	0.0094 J	0.009	0.010	0.050	No
Barium	mg/L	0.13	0.13	0.094	0.094	0.112	0.122	0.630	No
Metals/Inorganics (Unfiltered)									
Arsenic	mg/L	0.012	0.0063	0.008 J	0.012 J	0.010	0.011	0.050	No
Barium	mg/L	0.12	0.13	0.099	0.099	0.112	0.120	0.630	No
Chromium	mg/L	0.035	0.0072	0.012	0.005 U	0.014	0.021	0.743	No
Copper	mg/L	0.023	0.01 U	0.01 U	0.015 U*	0.010	0.014	0.031	No
Lead	mg/L	0.0061	0.003 UJ	0.003 U	0.003 U	0.003	0.004	0.010	No
Total Cyanide	mg/L	1.2	1.1	1.4	1.3 J	1.250	1.313	0.172	Yes
Zinc	mg/L	0.12	0.024 U*	0.028 U*	0.18 U*	0.059	0.086	0.081	Yes

Notes:

U This compound was not detected at or above the associated numerical value. (Quantitation limit shown.)
U* This compound should be considered "not detected" since it was detected in a blank at a similar level. (Quantitation limit shown.)
J Quantitation is approximate due to limitations identified during the quality assurance review (data validation).
UJ This compound was not detected, but the quantitation limit is probably higher due to a low bias identified during the quality assurance review. (Quantitation limit shown.)
UR Unusable "not detected" result; compound may or may not be present in this sample. (Quantitation limit shown.)

Shaded values indicate constituent concentrations which exceed the preliminary site-specific action levels (PSALs).

R and UR flagged values are not included in the associated statistical calculations because these results are considered unusable.

(1) 80% UCL = Mean + [t-value for 0.80, n-1](Standard Deviation/n^0.5), where n=number of samples

TABLE 7-43

Detected Constituent Concentrations and PSAL Comparison for Groundwater Samples from Perimeter Monitoring Well PM1NA
BASF - Wyandotte RFI

		QUARTERLY SAMPLING EVENT				STATISTICAL VALUES			
CONSTITUENT	UNITS	1st Quarterly 9/17/96	2nd Quarterly 12/20/96	3rd Quarterly 3/21/97	4th Quarterly 6/4/97	MEAN	80% UCL (1)	PSAL	80% UCL Exceed PSAL?
Volatile Organics									
Benzene	ug/L	1 UJ	5 UJ	1.9 J	25 U	4.35	7.04	53.00	No
Carbon disulfide	ug/L	2.3 J	3.5 J	1.5 J	2.3 J	2.40	2.80	1600.00	No
Semi-Volatile Organics									
2,6-Dichlorophenol	ug/L	10 U	2.8 J	2.9 J	2.4 J	3.28	3.85	10.00	No
3-Methylphenol	ug/L	10 U	4.2 JN	2 JN	1.2 JN	3.10	3.98	1800.00	No
4-Methylphenol	ug/L	10 U	4.2 JN	2 JN	1.2 JN	3.10	3.98	10.00	No
Metals/Inorganics (Filtered)									
Arsenic	mg/L	0.012	0.56	0.57 J	0.49 J	0.408	0.538	0.050	Yes
Barium	mg/L	0.072	0.048	0.041	0.05	0.053	0.059	0.630	No
Chromium	mg/L	0.005 U	0.027	0.02	0.02 J	0.017	0.022	0.743	No
Vanadium	mg/L	0.02 U	0.044	0.034	0.031	0.030	0.037	0.027	Yes
Metals/Inorganics (Unfiltered)									
Arsenic	mg/L	0.031	0.66	0.44 J	0.64 J	0.443	0.585	0.050	Yes
Barium	mg/L	0.3	0.069	0.093	0.18	0.161	0.212	0.630	No
Chromium	mg/L	0.14	0.04	0.028	0.12 J	0.082	0.110	0.743	No
Lead	mg/L	0.089 J	0.014	0.01	0.087	0.050	0.071	0.010	Yes
Total Cyanide	mg/L	0.12 J	15	14	0.068 J	7.297	11.369	0.172	Yes
Vanadium	mg/L	0.085	0.055	0.035	0.068	0.061	0.071	0.027	Yes
Zinc	mg/L	0.45	0.065 U*	0.062	0.25 U*	0.167	0.261	0.081	Yes
Miscellaneous									
Acid-insoluble Sulfide	mg/L	24 J	8	17	51	25.00	34.06	NA	NA

Notes:

U This compound was not detected at or above the associated numerical value. (Quantitation limit shown.)
U* This compound should be considered "not detected" since it was detected in a blank at a similar level. (Quantitation limit shown.)
J Quantitation is approximate due to limitations identified during the quality assurance review (data validation).
UJ This compound was not detected, but the quantitation limit is probably higher due to a low bias identified during the quality assurance review. (Quantitation limit shown.)
JN Quantitation is approximate due to limitations identified during the quality assurance review (data validation). This result should be considered a tentative qualitative identification.

Shaded values indicate constituent concentrations which exceed the preliminary site-specific action levels (PSALs).

(1) 80% UCL = Mean + [t-value for 0.80, n-1](Standard Deviation/n^0.5), where n=number of samples

TABLE 7-44

Summary of Detected Constituent Concentrations and PSAL Comparison for Groundwater Samples from Non-Network Monitoring Wells
BASF - Wyandotte RFI

CONSTITUENT	UNITS	MW000RFIMW-13	MW000RFIMW-14	MW000RFIMW-15	MW000RFIMW-16	MW000RFIMW-18 (MS/MSD)	MW000RFIMW-21	MW000RFIMW-28	MW000TMW-1	MW000TMW-2	MW000TMW-2D	MW000PM1NB	MW000PM3NB	GROUNDWATER PSALs
Volatile Organics														
Acetone	ug/L	10 UR	NA	10 UR	540 J	10 UR	2100 J	10.50	NA	NA	NA	10 UR	10 UR	25,000.00
Benzene	ug/L	8.4 J	NA	1 UJ	1.9 UJ	1 UJ	6.2 UJ	1.78	NA	NA	NA	1 UJ	1 UJ	53.00 ?
Carbon disulfide	ug/L	0.78 J	NA	1 UJ	3.4 J	1 UJ	6.2 UJ	1.17	NA	NA	NA	3.1 J	0.63 J	1,600.00
1,2-Dichloroethane	ug/L	28 J	NA	1 UJ	1.9 UJ	1 UJ	6.2 UJ	1.42	NA	NA	NA	1 UJ	1 UJ	560.00
Methyl ethyl ketone	ug/L	10 UJ	NA	10 UJ	43 J	10 UJ	62 UJ	9.58	NA	NA	NA	10 UJ	10 UJ	7,200.00
Propylene oxide	mg/L	NA	1 U	NA	NA	NA	NA	NA	1 U	2	1.9	NA	NA	N/A
Toluene	ug/L	1 UJ	NA	1 UJ	2 J	1 UJ	6.2 UJ	1.42	NA	NA	NA	1 UJ	1 UJ	110.00
Semi-Volatile Organics														
bis(2-Chloroisopropyl) ether	ug/L	100 U	NA	10 U	200 U	10 U	40 U	5.00	NA	NA	NA	10 U	39	10.00
1,4-Dioxane	ug/L	240 J	NA	50 U	39 J	3.8 J	200 U	25.00	NA	NA	NA	50 U	3.2 J	2,000.00
2,4-Dimethylphenol	ug/L	50 U	NA	5 U	100 U	5 U	20 U	23.77	NA	NA	NA	5 U	5 U	30.00
2-Methylphenol	ug/L	50 U	NA	5 U	100 U	5 U	20 U	4.72	NA	NA	NA	5 U	5 U	38.00
3-Methylphenol	ug/L	100 U	NA	10 U	200 U	10 U	40 U	16.71	NA	NA	NA	10 U	10 U	1,800.00
4-Methylphenol	ug/L	100 U	NA	10 U	200 U	10 U	40 U	16.71	NA	NA	NA	10 U	10 U	10.00
Phenol	ug/L	50 U	NA	5 U	350	5 UR	18 J	2.50	NA	NA	NA	5 U	5 U	1,100.00
Pyridine	ug/L	100 U	NA	10 U	200 U	10 U	40 U	3.98	NA	NA	NA	10 U	10 U	20.00
Metals/Inorganics (Filtered)														
Arsenic	mg/L	0.011	NA	0.005 U	0.045 J	NA	NA	0.041	NA	NA	NA	NA	NA	0.050
Barium	mg/L	0.12	NA	0.16	0.24	NA	NA	0.048	NA	NA	NA	NA	NA	0.630
Cadmium	mg/L	0.001 U	NA	0.0023	0.001 U	NA	NA	0.002	NA	NA	NA	NA	NA	0.0008
Chromium	mg/L	0.005 U	NA	0.005 U	0.0076	NA	NA	0.003	NA	NA	NA	NA	NA	0.743
Selenium	mg/L	0.005 U	NA	0.005 U	0.0076	NA	NA	0.003	NA	NA	NA	NA	NA	0.005
Vanadium	mg/L	0.02 U	NA	0.02 U	0.18	NA	NA	0.010	NA	NA	NA	NA	NA	0.027
Zinc	mg/L	0.036 U*	NA	0.02 U	0.025 U*	NA	NA	0.030	NA	NA	NA	NA	NA	0.081
Metals/Inorganics (Unfiltered)														
Arsenic	mg/L	0.0088	NA	0.084	0.039 J	NA	NA	0.047	NA	NA	NA	NA	NA	0.050
Barium	mg/L	0.2	NA	0.3	0.24	NA	NA	0.071	NA	NA	NA	NA	NA	0.630
Cadmium	mg/L	0.001 U	NA	0.0052	0.001 U	NA	NA	0.002	NA	NA	NA	NA	NA	0.0008
Chromium	mg/L	0.04	NA	0.12	0.04	NA	NA	0.015	NA	NA	NA	NA	NA	0.743
Copper	mg/L	0.015 J	NA	0.13	0.018 J	NA	NA	0.024	NA	NA	NA	NA	NA	0.031
Lead	mg/L	0.003 U	NA	0.062	0.003	NA	NA	0.005	NA	NA	NA	NA	NA	0.010
Mercury	mg/L	0.0002 U	NA	0.0012	0.0002 U	NA	NA	0.00010	NA	NA	NA	NA	NA	0.0001
Nickel	mg/L	0.04 U	NA	0.15	0.044	NA	NA	0.027	NA	NA	NA	NA	NA	0.238
Selenium	mg/L	0.005 U	NA	0.005 U	0.0065	NA	NA	0.003	NA	NA	NA	NA	NA	0.005
Total Cyanide	mg/L	0.046 J	NA	0.069 J	0.39 J	NA	NA	0.015	NA	NA	NA	NA	NA	0.172
Vanadium	mg/L	0.02 U	NA	0.095	0.2	NA	NA	0.028	NA	NA	NA	NA	NA	0.027
Zinc	mg/L	0.18	NA	0.54	0.047 U*	NA	NA	0.055	NA	NA	NA	NA	NA	0.081
Miscellaneous														
Acid-insoluble Sulfide	mg/L	1 U	NA	1 U	4	NA	NA	0.50	NA	NA	NA	NA	NA	N/A

Notes:

- U This compound was not detected at or above the associated numerical value. (Quantitation limit shown.)
- U* This compound should be considered "not detected" since it was detected in a blank at a similar level. (Quantitation limit shown.)
- J Quantitation is approximate due to limitations identified during the quality assurance review (data validation).
- UJ This compound was not detected, but the quantitation limit is probably higher due to a low bias identified during the quality assurance review. (Quantitation limit shown.)
- UR Unusable "not detected" result; compound may or may not be present in this sample. (Quantitation limit shown.)
- NA Not analyzed.

Data for MW-28 represent mean values for three monthly sampling events and three quarterly events.

Shaded values indicate constituent concentrations which exceed the preliminary site-specific action levels.

TABLE 7-45

Constituents of Concern and 80% UCL Values for Soil by SWMU/AOC
BASF - Wyandotte RFI

SWMU F	SWMU G	SWMU H	AOC 2	AOC 4 (Tar)	AOC 6	AOC 7A	AOC 7B	AOC 7C
Volatile Organics (ug/kg)								
Benzene 1,325		Acetone 737,716		Benzene 680,000				
1,2-Dichloropropane 15,621		Benzene 179,387		Styrene 240,000				
Toluene 34,425		Chlorobenzene 179,391		Toluene 590,000				
m-Xylene & p-Xylene 1,300		1,2-Dichlorobenzene 179,378		m-Xylene & p-Xylene 740,000				
		1,2-Dichloropropane 9,440,556		o-Xylene 240,000				
		Ethylbenzene 179,359						
		Methyl ethyl ketone 737,715						
		m-Xylene & p-Xylene 91,897						
		o-Xylene 91,714						
		Toluene 179,841						
		1,2,3-Trichloropropane 180,835						
Semi-Volatile Organics (ug/kg)								
Acenaphthene 4,080	Acenaphthene 549	Acenaphthene 20,949	2-Methylnaphthalene 1,054	Acenaphthylene 9,300,000	Acenaphthene 1,931			
Benzo(a)anthracene 4,203	Benzo(a)anthracene 1,044	Benzo(a)anthracene 20,596	Naphthalene 945	Anthracene 7,100,000	Acenaphthylene 2,302			
Benzo(a)pyrene 4,130	Benzo(a)pyrene 1,091	Benzo(a)pyrene 20,462	Phenanthrene 665	Benzo(a)anthracene 4,900,000	Benzo(a)anthracene 10,958			
Benzo(b)fluoranthene 4,172	Benzo(b)fluoranthene 1,536	Benzo(b)fluoranthene 20,579		Benzo(b)fluoranthene 4,400,000	Benzo(b)fluoranthene 14,757			
Benzo(ghi)perylene 4,073	Chrysene 1,115	Benzo(ghi)perylene 21,068		Benzo(k)fluoranthene 2,500,000	Benzo(k)fluoranthene 5,062			
Benzo(k)fluoranthene 4,035	Indeno(1,2,3-cd)pyrene 730	Benzo(k)fluoranthene 21,063		Benzo(ghi)perylene 1,500,000	Benzo(ghi)perylene 6,202			
Benzyl alcohol 6,293	Pentachlorophenol 176	bis(2-Chloroethyl) ether 21,320		Benzo(a)pyrene 4,100,000	Benzo(a)pyrene 10,211			
bis(2-Chloroisopropyl) ether 8,317	Phenanthrene 941	bis(2-Chloroisopropyl) ether 278,933		Chrysene 5,200,000	Chrysene 10,059			
Chrysene 4,187		bis(2-Ethylhexyl) phthalate 21,271		Dibenzofuran 5,900,000	Dibenz(a,h)anthracene 2,290			
2,4-Dimethylphenol 7,099		4-Chloro-3-methylphenol 21,337		Fluoranthene 14,000,000	2,4-Dimethylphenol 2,032			
Indeno(1,2,3-cd)pyrene 4,099		2-Chlorophenol 21,319		Fluorene 9,500,000	Fluoranthene 19,922			
2-Methylnaphthalene 4,085		Chrysene 20,627		Indeno(1,2,3-cd)pyrene 1,600,000	Indeno(1,2,3-cd)pyrene 6,380			
2-Methylphenol 4,403		2,4-Dimethylphenol 20,957		2-Methylnaphthalene 9,000,000	2-Methylnaphthalene 2,007			
4-Methylphenol 5,131		2,4-Dinitrotoluene 21,264		3-Methylphenol 2,700,000	2-Methylphenol 2,032			
Naphthalene 4,001		Fluoranthene 21,223		4-Methylphenol 2,700,000	Naphthalene 1,160			
Pentachlorophenol 17		Indeno(1,2,3-cd)pyrene 21,065		Naphthalene 48,000,000	Phenanthrene 17,376			
Phenanthrene 4,714		2-Methylnaphthalene 20,763		Phenanthrene 23,000,000				
		4-Methylphenol 20,405		Phenol 2,300,000				
		Naphthalene 21,713		Pyrene 9,900,000				
		4-Nitrophenol 100,886						
		N-Nitrosodi-n-propylamine 21,219						
		Pentachlorophenol 85						
		Phenanthrene 22,151						
		1,2,4-Trichlorobenzene 21,219						
Pesticides (ug/kg)								
Aroclor 1254 769	Aroclor 1260 491	alpha-Chlordane 6						
4,4'-DDE 15		Aroclor 1248 422						
		Aroclor 1254 358						
Metals/Inorganics (mg/kg)								
Antimony 3.4	Arsenic 35.5	Antimony 17.3	Arsenic 22.4	Arsenic 21	Arsenic 24.5	Arsenic 19.2	Total Cyanide 0.2	Arsenic 29.8
Arsenic 29.4	Lead 92.0	Arsenic 118.6	Chromium 35.8	Lead 83	Chromium 29.1	Mercury 1.3		Lead 65.5
Chromium 34.3	Mercury 1.2	Beryllium 2.7	Mercury 4.3	Selenium 4	Lead 145.6	Silver 5.1		Mercury 1.1
Cobalt 11.3	Total Cyanide 0.2	Cadmium 3.3	Total Cyanide 15.5	Thallium 14	Mercury 1.3	Total Cyanide 1.0		Nickel 52.1
Copper 1471.8		Chromium 62.3	Zinc 278.4	Total Cyanide 19	Nickel 23.8			Zinc 312.3
Lead 184.9		Cobalt 29.7			Total Cyanide 1.3			Total Cyanide 0.2
Mercury 4.7		Copper 68.4						
Nickel 42.2		Lead 111.7						
Total Cyanide 2.7		Mercury 10.3						
Zinc 246.2		Nickel 55.1						
		Selenium 92.0						
		Silver 6.2						
		Thallium 87.6						
		Total Cyanide 4.0						
		Vanadium 49.4						

TABLE 7-46

Constituents of Concern for Groundwater
BASF - Wyandotte RFI

Constituent	Groundwater Concentration (1)
Volatile Organics (ug/L)	
Benzene	2,834.70
Chlorobenzene	67.78
Vinyl chloride	224.84
Semi-Volatile Organics (ug/L)	
Acenaphthene	8.01
Benzo(a)anthracene	10.92
Benzo(a)pyrene	7.39
Benzo(b)fluoranthene	8.80
bis(2-Chloroethyl) ether	106.60
bis(2-Chloroisopropyl) ether	39.00
Chrysene	8.06
2-Methylnaphthalene	101.73
4-Methylphenol	154.30
Naphthalene	61.83
o-Toluidine	236.42
Phenanthrene	7.77
Pyridine	232.51
Metals/Inorganics (mg/L)	
Arsenic	0.585
Barium	1.620
Cadmium	0.0052
Copper	0.370
Lead	0.209
Mercury	0.006
Nickel	0.266
Selenium	0.023
Total Cyanide	42.866
Vanadium	1.099
Zinc	0.540

(1) Highest value of the following:
- highest 80% UCL value from the set of perimeter wells, or
- highest analytical result for any individual non-network monitoring well.

TABLE 7-47

Detected Constituent Concentrations for Stormwater Runoff Samples
BASF - Wyandotte RFI

ANALYTE	UNITS	SW000AOC6	SW000AOC7	SW000 CEMT	PSAL
		SAMPLE ID NUMBERS AND RESULTS			
Volatile Organics					
Acetone	ug/L	13 J	10 J	10 UR	25,000
Metals/Inorganics					
Antimony	mg/L	0.0057	0.005 U	0.005 U	0.050
Arsenic	mg/L	0.036	0.051	0.005 U	0.050
Barium	mg/L	0.22	0.47	0.031	0.630
Cadmium	mg/L	0.001 U	0.002	0.001 U	0.001
Chromium	mg/L	0.057	0.1	0.005 U	0.743
Copper	mg/L	0.062	0.12	0.01 U	0.031
Lead	mg/L	0.043	0.11	0.003 U	0.010
Mercury	mg/L	0.00023	0.00086	0.0002 U	0.0001
Nickel	mg/L	0.06	0.13	0.04 U	0.238
Total Cyanide	mg/L	0.005 U	0.016	0.005 UJ	0.172
Vanadium	mg/L	0.092	0.14	0.02 U	0.027
Zinc	mg/L	0.22	0.52	0.02 U	0.081

Notes:

U This compound was not detected at or above the associated numerical value. (Quantitation limit shown.)
J Quantitation is approximate due to limitations identified during the quality assurance review (data validation).
UJ This compound was not detected, but the quantitation limit is probably higher due to a low bias identified during the quality assurance review. (Quantitation limit shown.)
UR Unusable "not detected" result; compound may or may not be present in this sample. (Quantitation limit shown.)

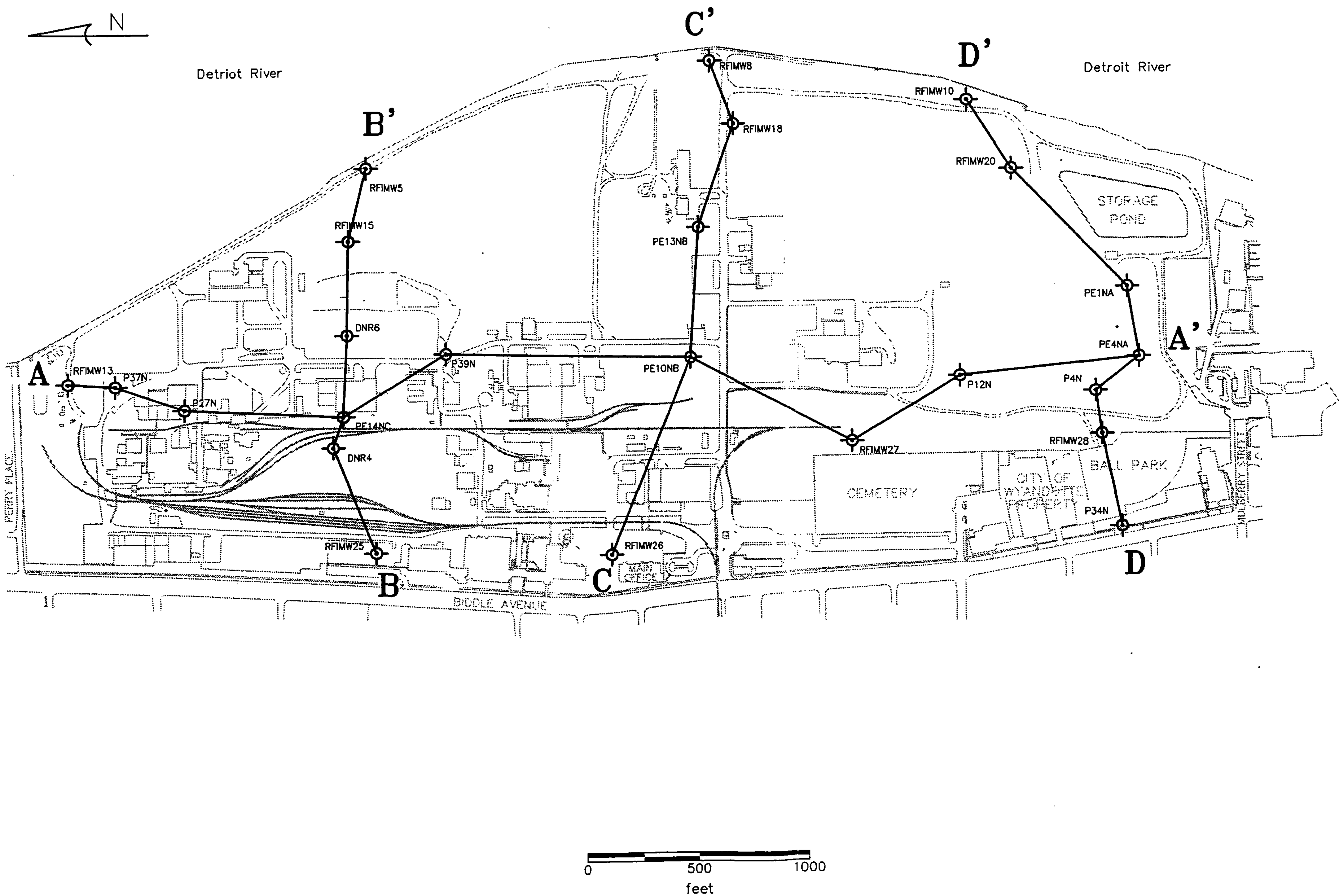
Shaded values indicate constituent concentrations which exceed the preliminary site-specific action levels (PSALs).

TABLE 7-48

Net COC Reduction Achieved by Groundwater Extraction System
BASF - Wyandotte RFI

Constituent of Concern	Units	Mean	Net Reduction of COCs (lb)*
Volatile Organics			
Benzene	ug/L	151.8	31.7
Chlorobenzene	ug/L	3.6	0.7
Vinyl chloride	ug/L	13.0	2.7
Semi-Volatile Organics			
Acenaphthene	ug/L	12.4	2.6
Benzo(a)anthracene	ug/L	12.9	2.7
Benzo(a)pyrene	ug/L	12.7	2.6
Benzo(b)fluoranthene	ug/L	12.8	2.7
bis(2-Chloroethyl) ether	ug/L	15.2	3.2
bis(2-Chloroisopropyl) ether	ug/L	25.4	5.3
Chrysene	ug/L	12.7	2.7
2-Methylnaphthalene	ug/L	17.9	3.7
4-Methylphenol	ug/L	33.8	7.1
Naphthalene	ug/L	15.4	3.2
o-Toluidine	ug/L	26.3	5.5
Phenanthrene	ug/L	12.3	2.6
Pyridine	ug/L	25.1	5.2
Metals/Inorganics			
Arsenic	mg/L	0.106	22.0
Barium	mg/L	0.383	80.0
Cadmium	mg/L	0.001	0.3
Copper	mg/L	0.039	8.2
Lead	mg/L	0.019	3.9
Mercury	mg/L	0.0006	0.1
Nickel	mg/L	0.056	11.7
Selenium	mg/L	0.005	0.9
Total Cyanide	mg/L	3.098	646.3
Vanadium	mg/L	0.105	21.8
Zinc	mg/L	0.094	19.6

* Net Reduction = (Volume of Extracted Groundwater) x (Mean COC Concentration), where the volume of extracted groundwater is assumed to be 25 million gallons over a ten-year period.



BASF

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Wyandotte, Michigan

Cross Section Boring Location

Figure 7-1
Cross Section Locations

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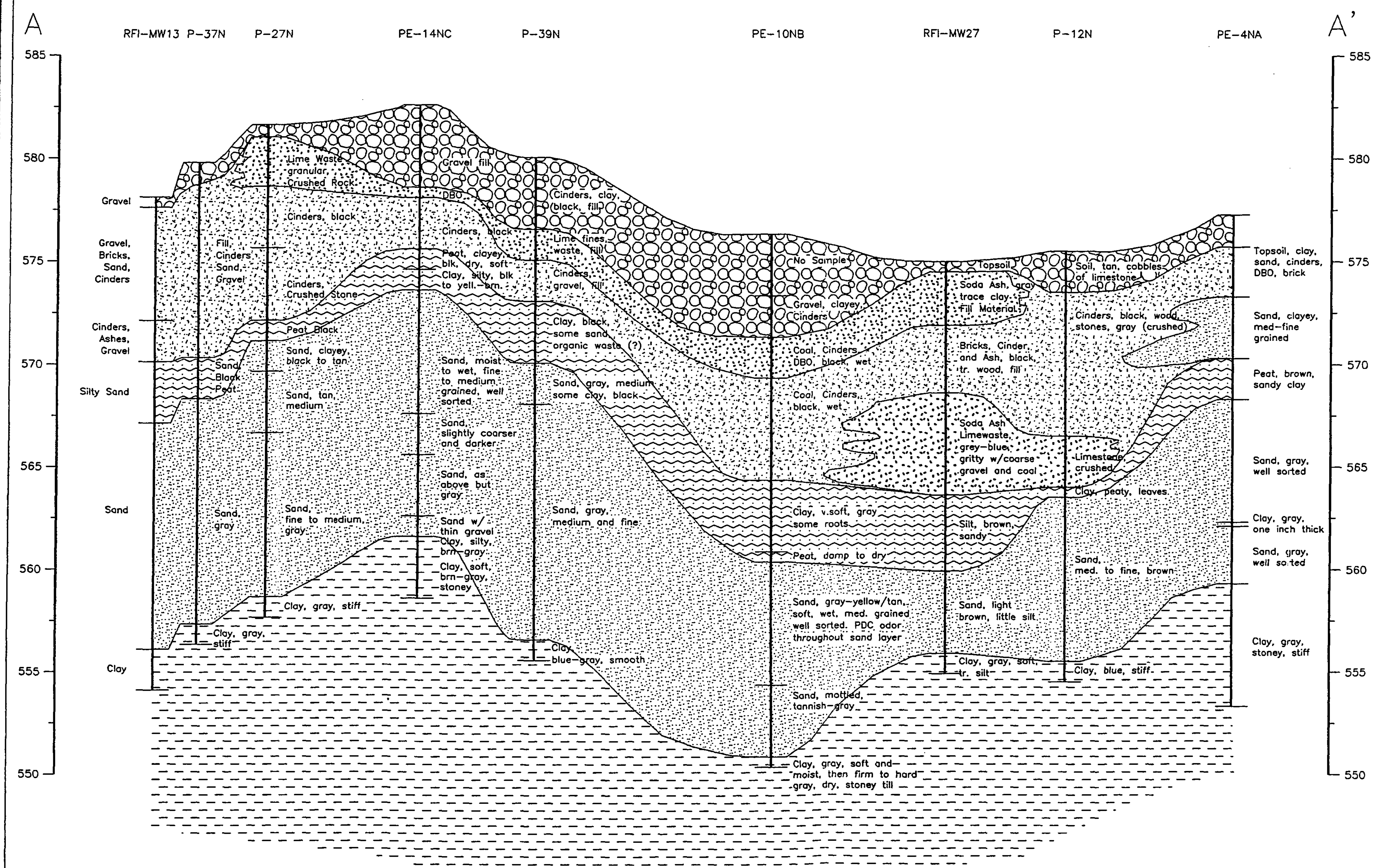

BASF

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Wyandotte, Michigan

Soil & Fill Pattern Explanation

- Peat & Clay Unit
- Native Sand Unit
- Lacustrine Unit
- DBO
- Gravel & Crushed Limestone
- Cinders

Elevations in feet relative to International Great Lakes Datum (1955)

Horizontal Scale:
0 500
feet

Vertical Exaggeration=100X

Figure 7–2
Cross Section
A–A'

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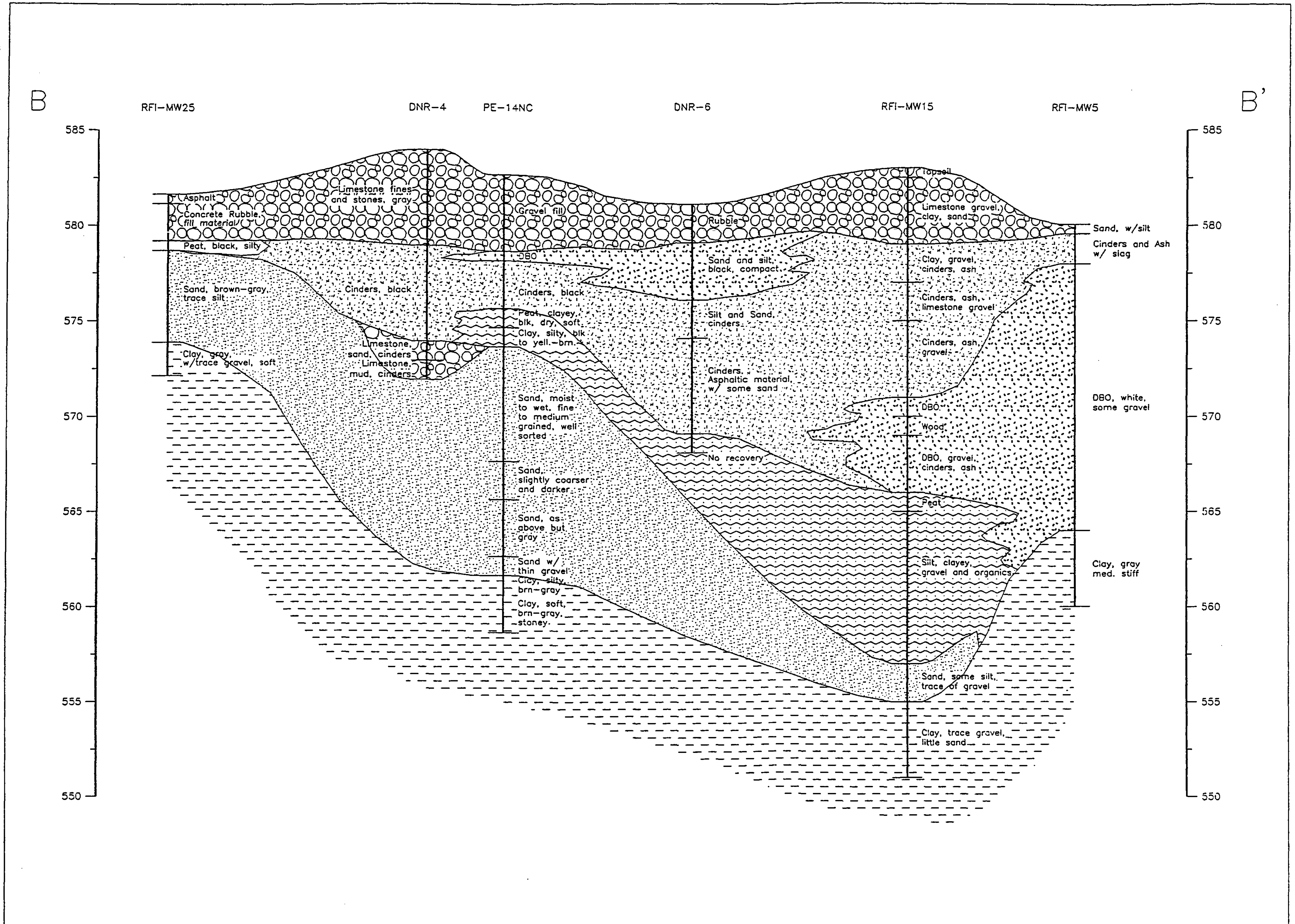


BASF

RCRA Facility Investigation
Wyandotte, Michigan

Soil & Fill Pattern Explanation

Peat & Clay Unit
DBO
Native Sand Unit
Gravel & Crushed Limestone
Lacustrine Unit
Cinders

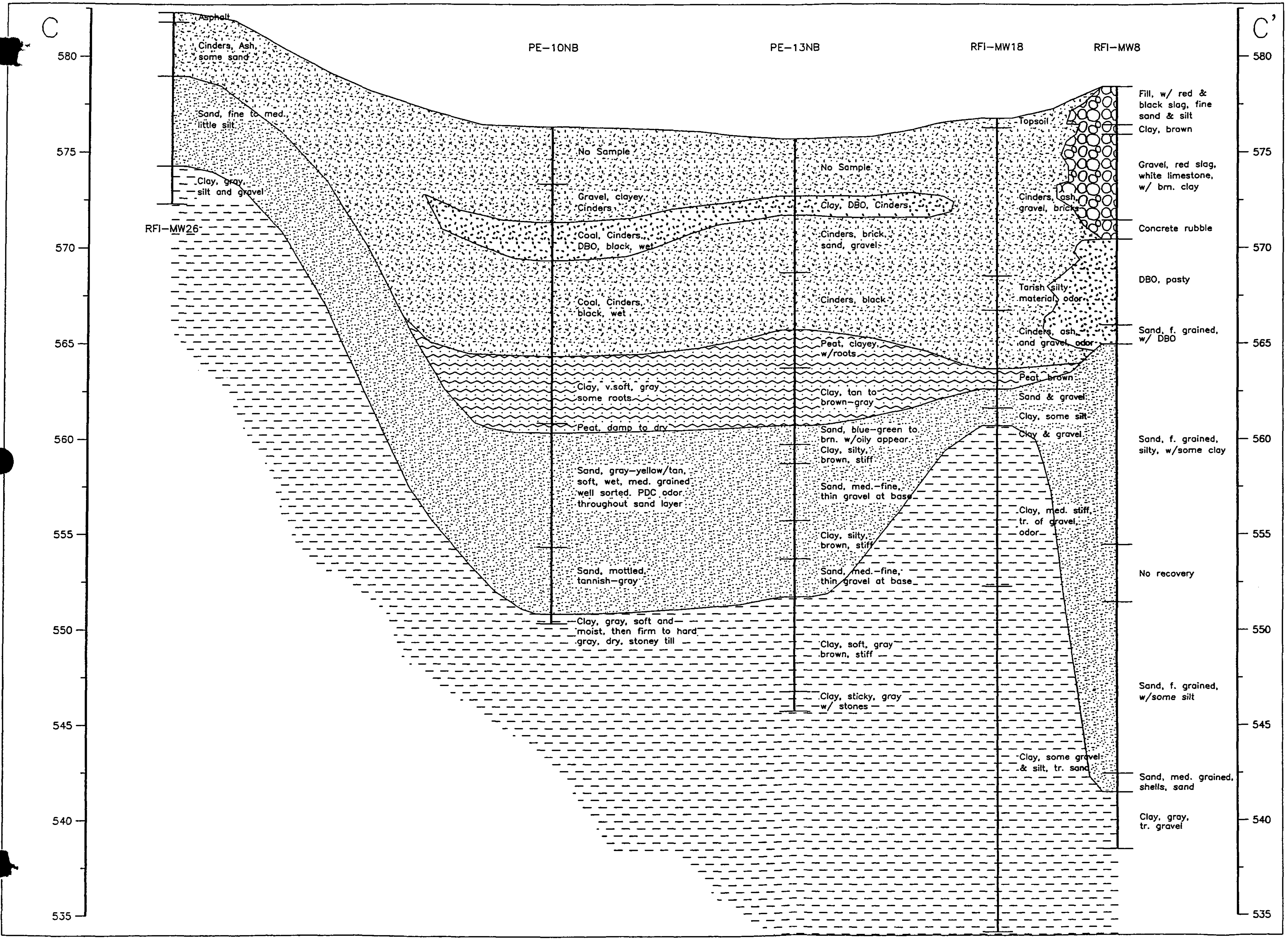
Elevations in feet relative to International Great Lakes Datum (1955)

Horizontal Scale:
0 200
feet

Vertical Exaggeration=40X

Figure 7-3
Cross Section
B-B'

QST ENVIRONMENTAL



BASF

RCRA Facility Investigation
Wyandotte, Michigan

Soil & Fill Pattern Explanation

- Peat & Clay Unit
- Native Sand Unit
- Lacustrine Unit
- DBO
- Gravel & Crushed Limestone
- Cinders

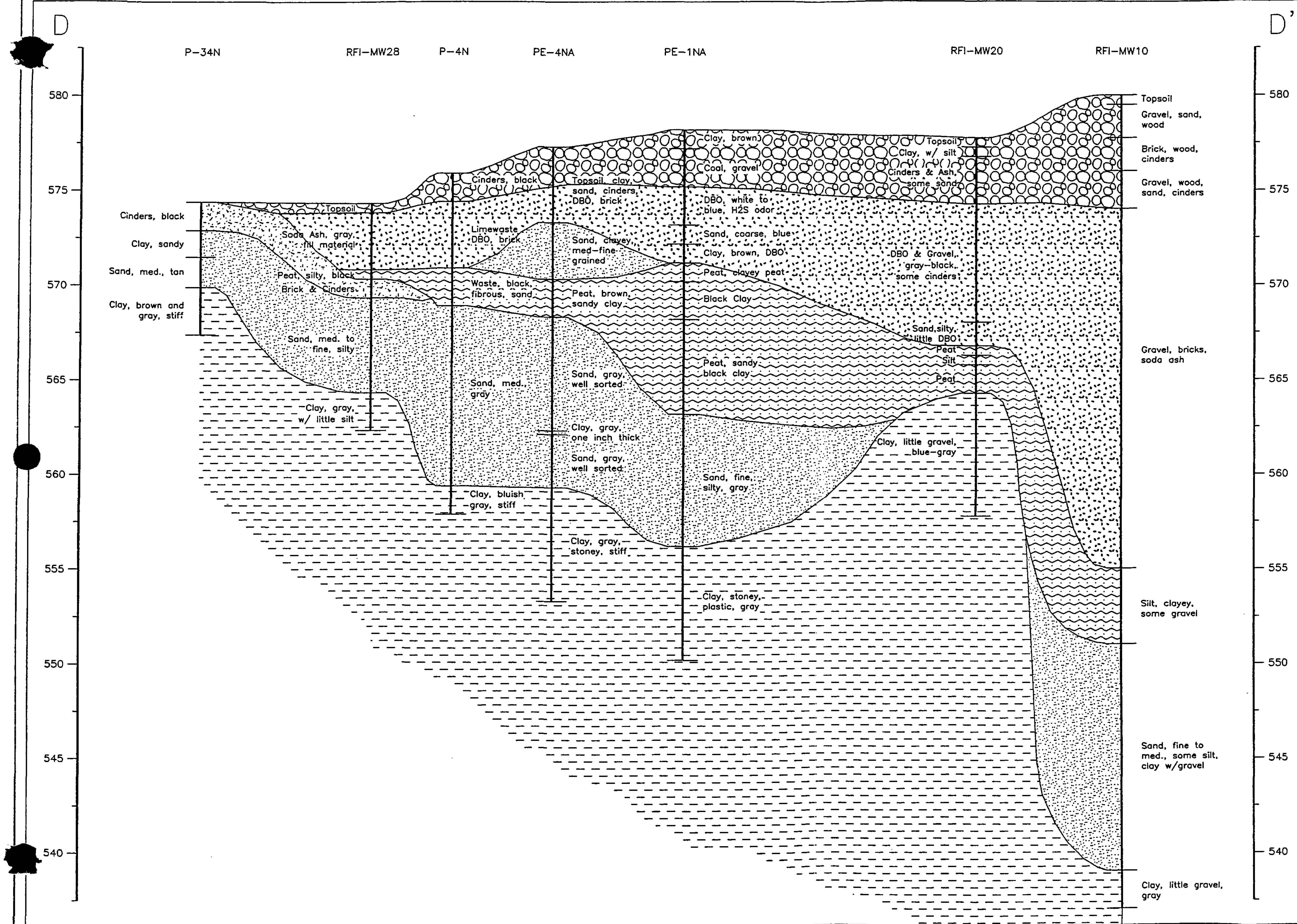
Elevations in feet relative to International Great Lakes Datum (1955)

Horizontal Scale:
0 — 250
feet

Vertical Exaggeration=50X

Figure 7-4
Cross Section
C-C'

QST ENVIRONMENTAL



BASF

RCRA Facility Investigation
Wyandotte, Michigan

Soil & Fill Pattern Explanation

- Peat & Clay Unit
- Native Sand Unit
- Lacustrine Unit
- DBO
- Gravel & Crushed Limestone
- Cinders

Elevations in feet relative to International Great Lakes Datum (1955)

Horizontal Scale:
0 250
feet

Vertical Exaggeration=50X

Figure 7-5
Cross Section
D-D'

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BASF

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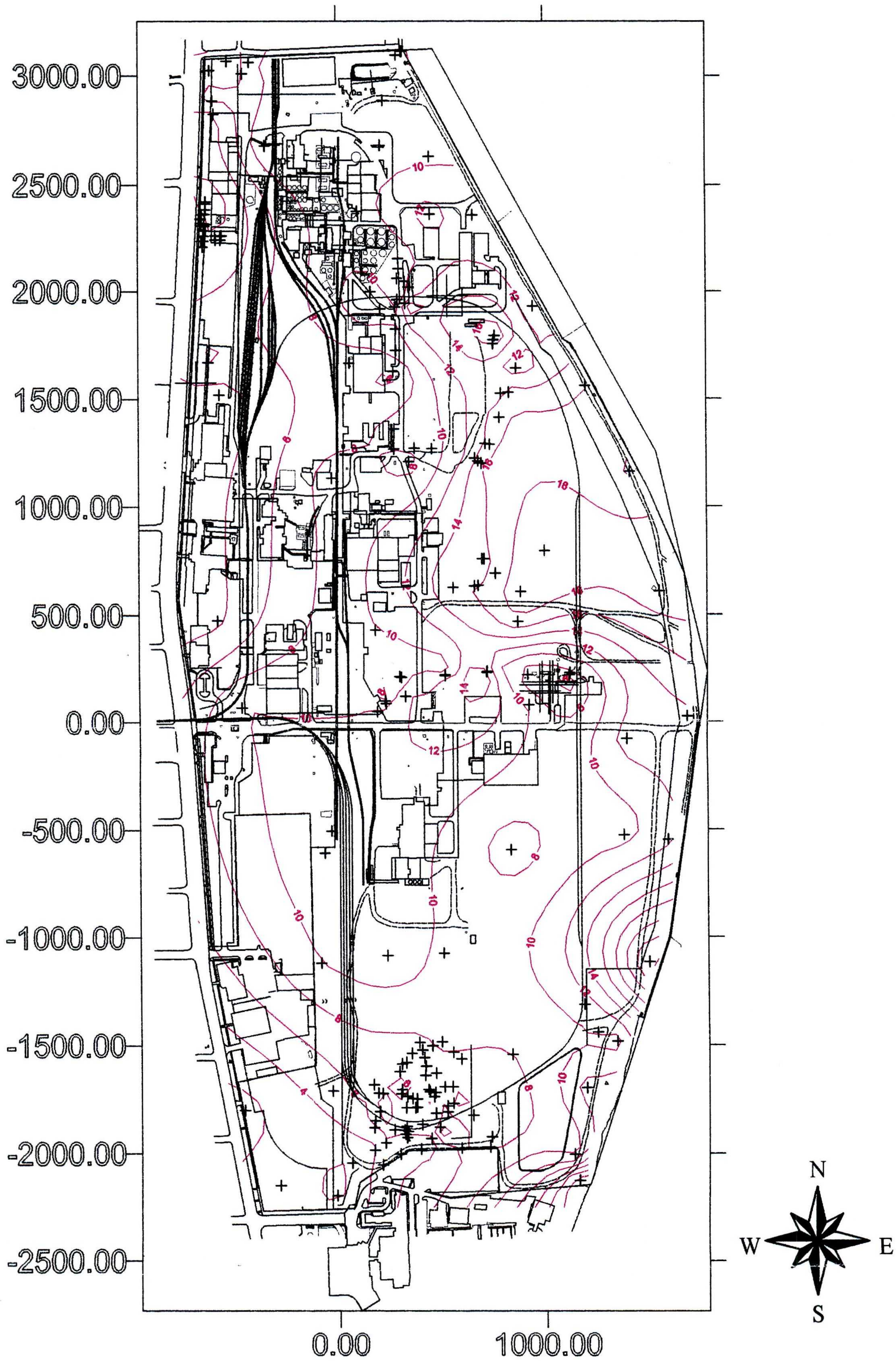
Wyandotte, Michigan



LEGEND

Thickness contours

Point of measured thickness

Notes:

1) Resolution = 70 feet

500 0 500

Feet

1:7000

Revised: 02-26-99

Figure 7-6. Isopach Map of Fill Material

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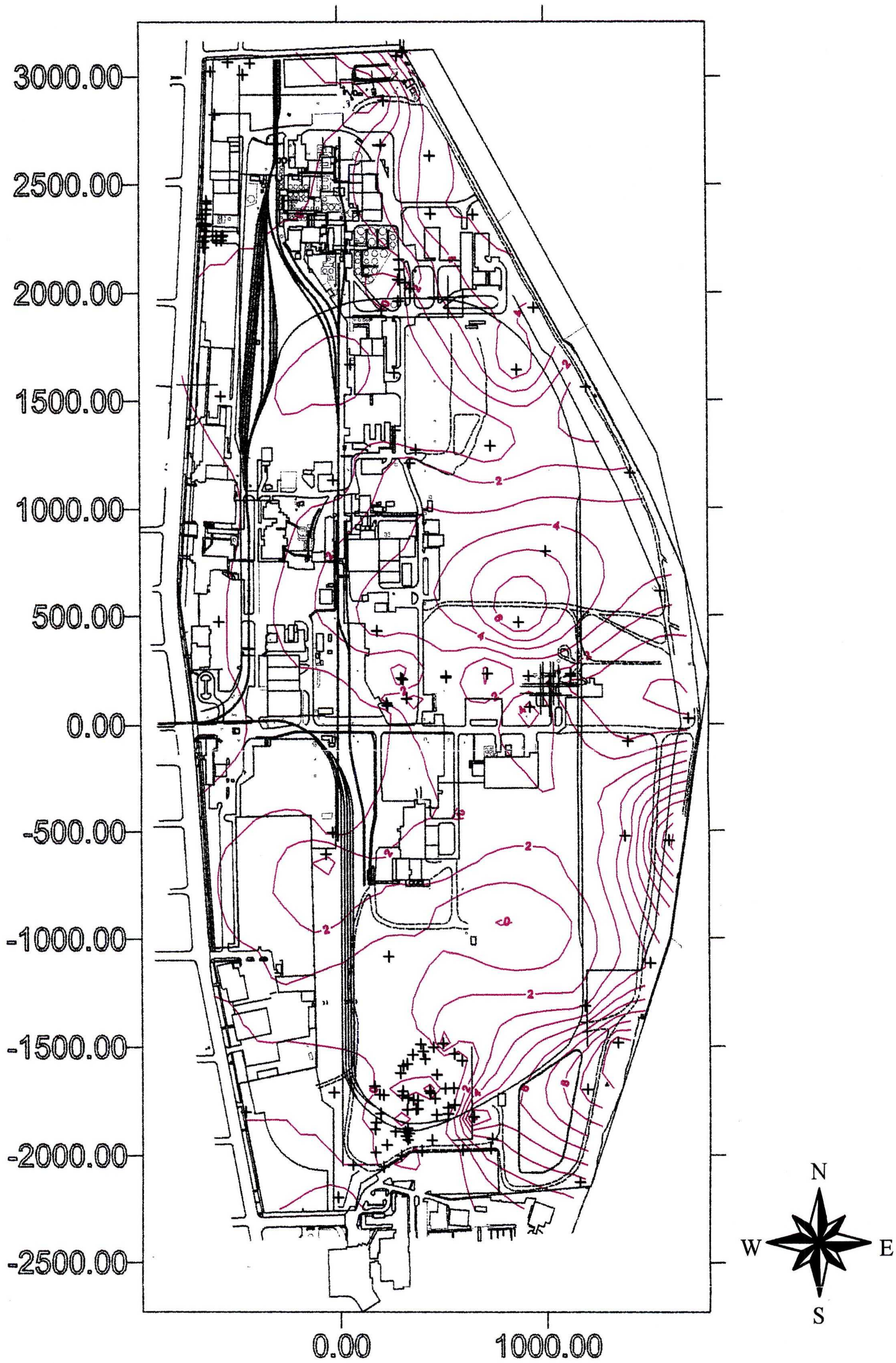
Wyandotte, Michigan



LEGEND

Thickness contours

Point of measured thickness

Notes:

1) Resolution = 70 feet

500 0 500

Feet

1:7000

Revised: 02-26-99

Figure 7-7. Isopach Map of Clay and Peat Unit

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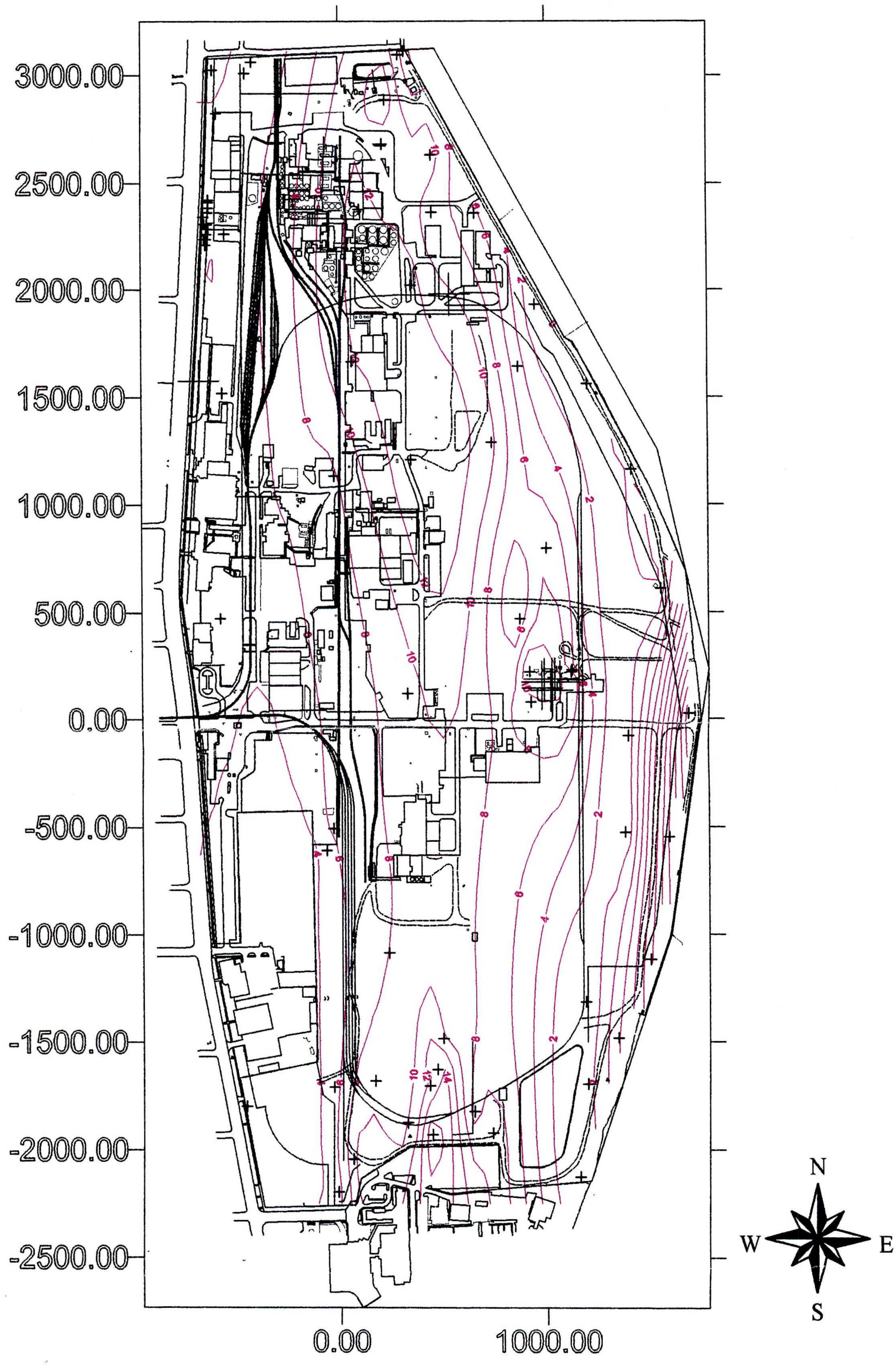

LEGEND

Thickness contours

Point of measured thickness

Notes:

1) Resolution = 70 feet

500 0 500

Feet

1:7000

Revised: 02-26-99

Figure 7-8. Isopach Map of Native Sand Unit

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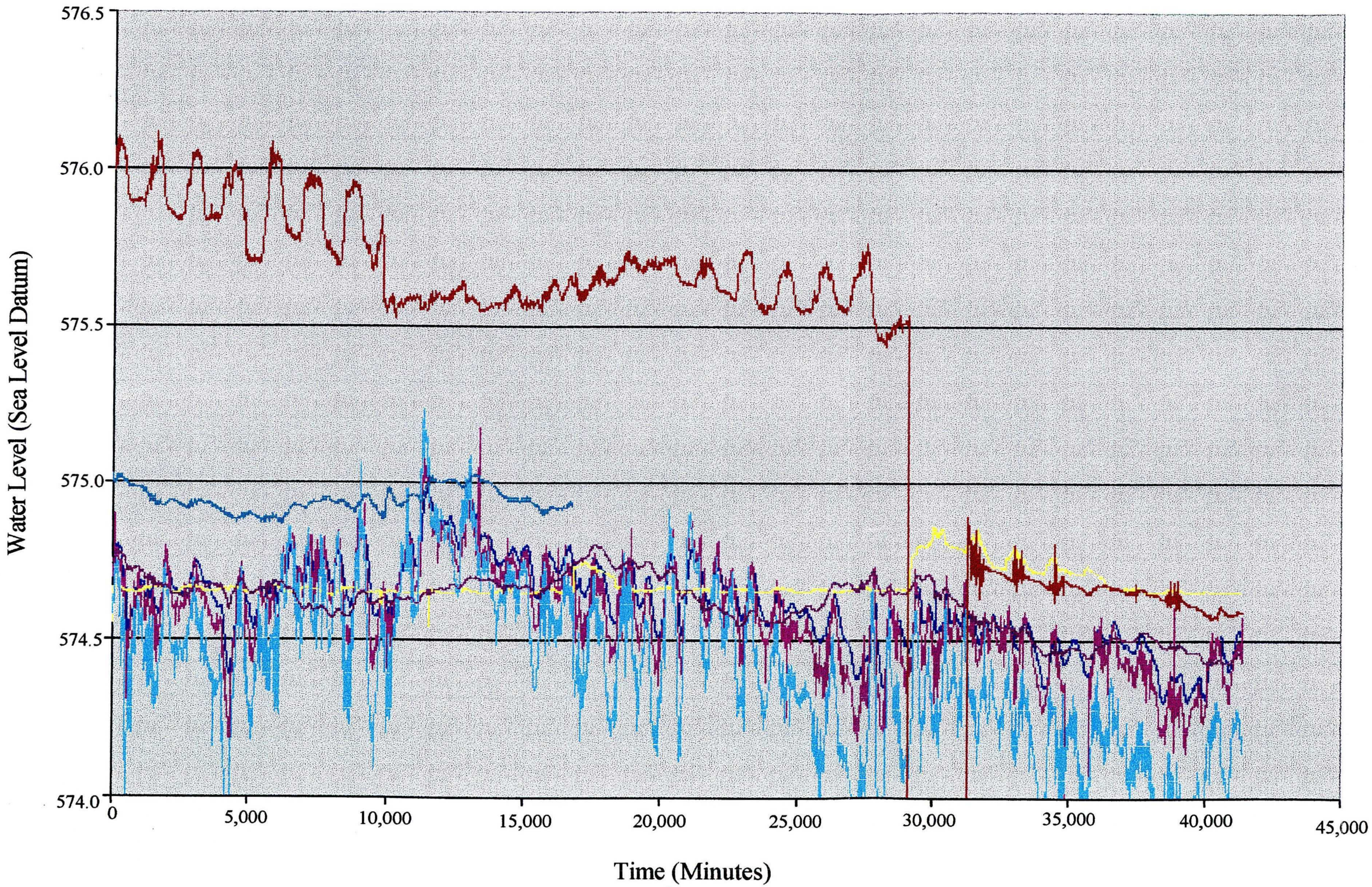

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LEGEND

MW#8
River N
MW#18
River S
MW#11
MW#20
MW#6

Revised: 02-26-99

Figure 7-10.
Water Level Data for
July 14 - August 8, 1997

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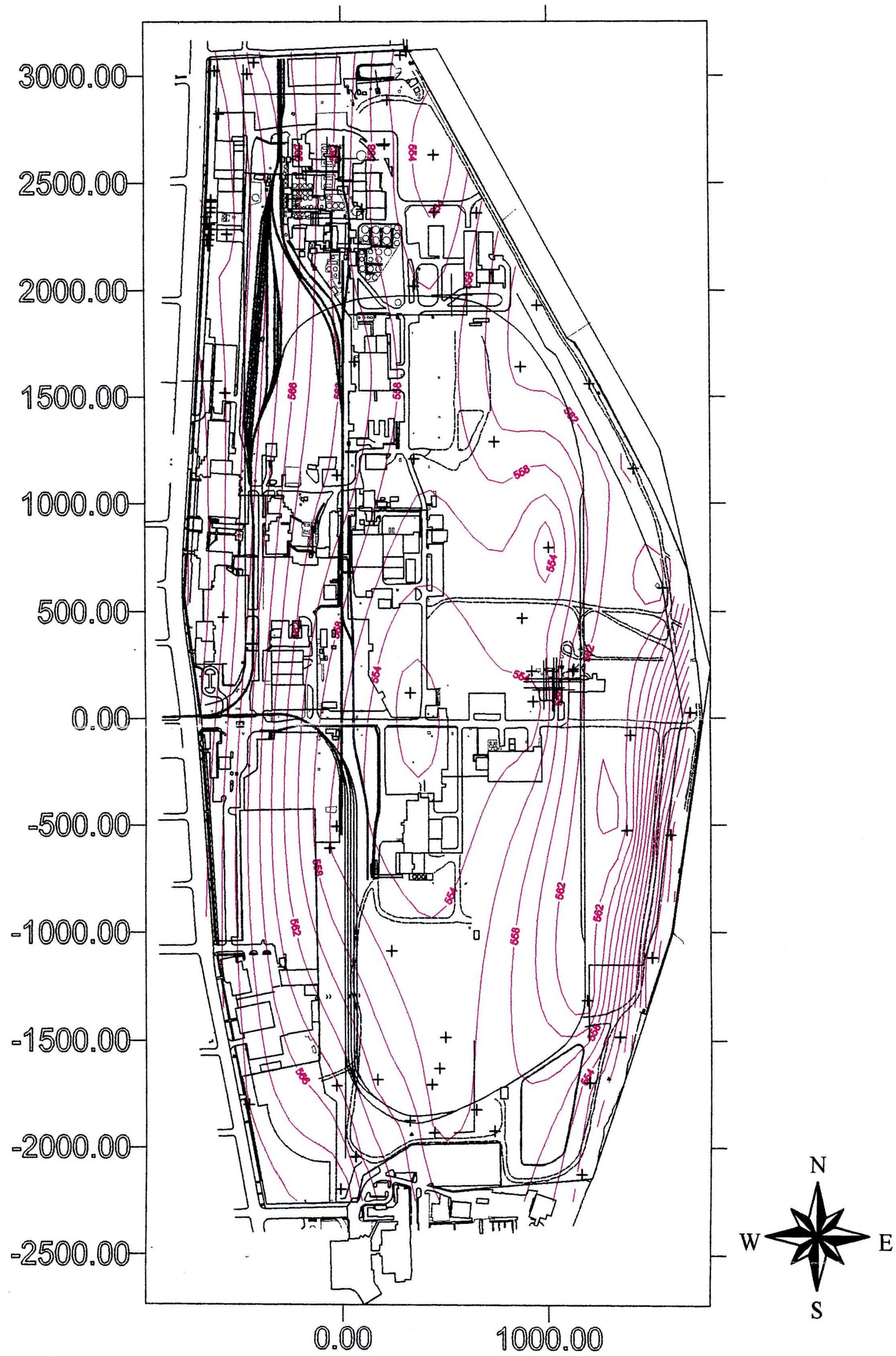

LEGEND

Elevation contours

Point of measured elevation

Notes:

1) Resolution = 70 feet

500 0 500

Feet

1:7000

Revised: 02-26-99

Figure 7-9. Elevation of Top of Lacustrine Clay Unit

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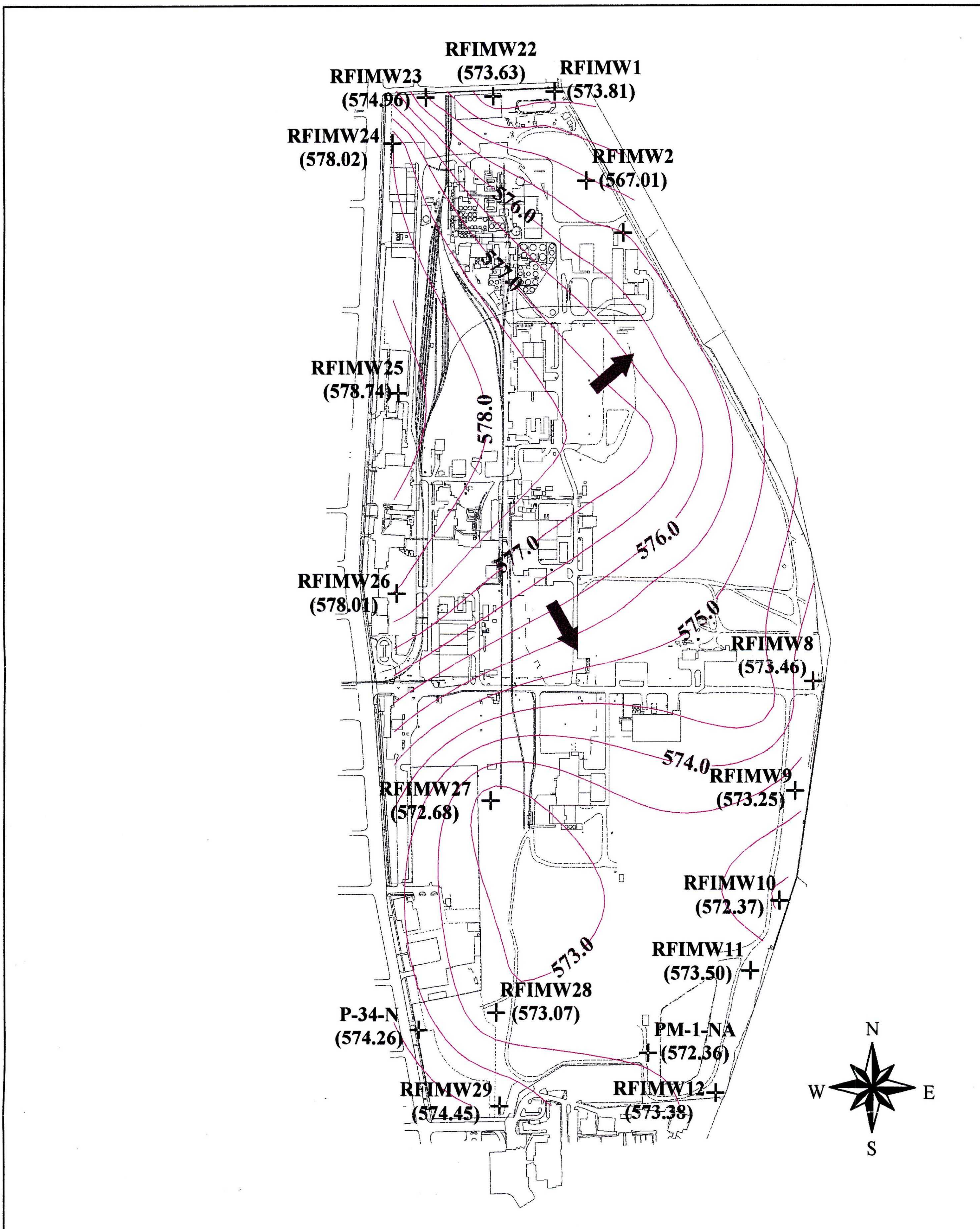
Wyandotte, Michigan



LEGEND

Elevation contours

Point of known elevation

Apparent direction of groundwater flow

500 0 500

Feet

1:6500

Revised: 02-26-99

Figure 7-11. Potentiometric Groundwater Surface (Sept. 1996)

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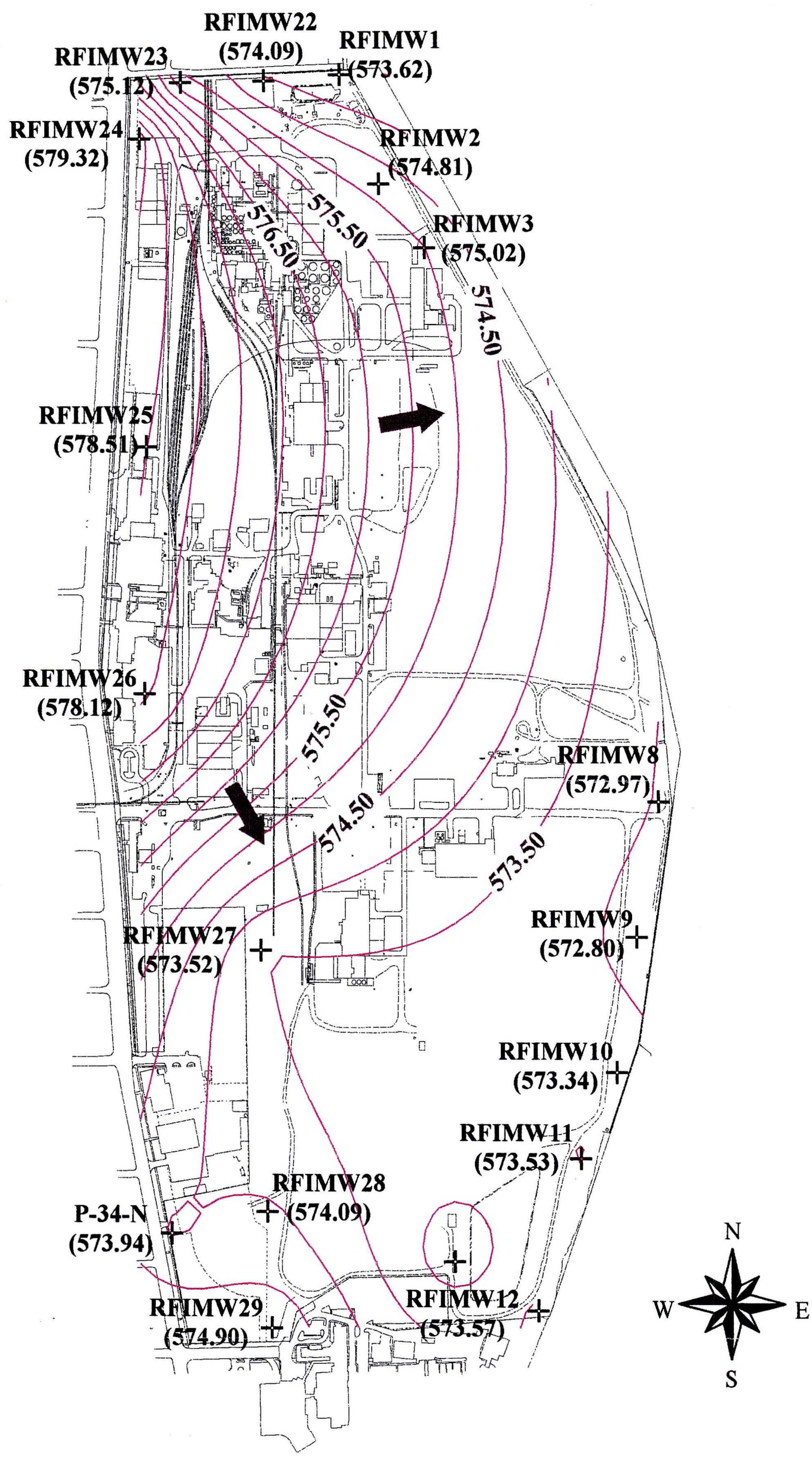

LEGEND

- Elevation contours
- Point of known elevation
- Apparent direction of groundwater flow

500 0 500

Feet

1:6500

Revised: 02-26-99

Figure 7-12. Potentiometric Groundwater Surface (Dec. 1996)

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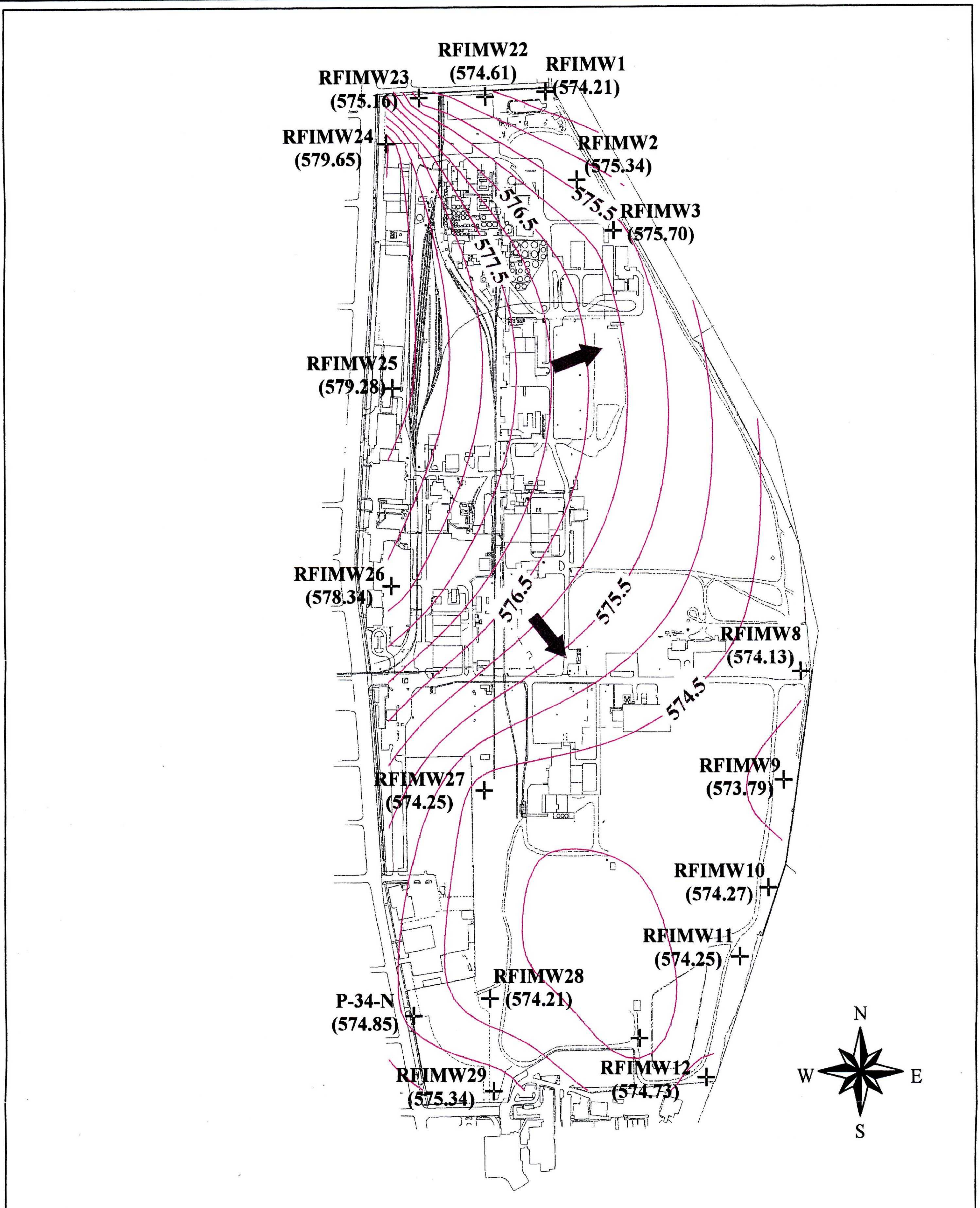
Wyandotte, Michigan



LEGEND

Elevation contours

Point of known elevation

Apparent direction of groundwater flow

500 0 500

Feet

1:6500

Revised: 02-26-99

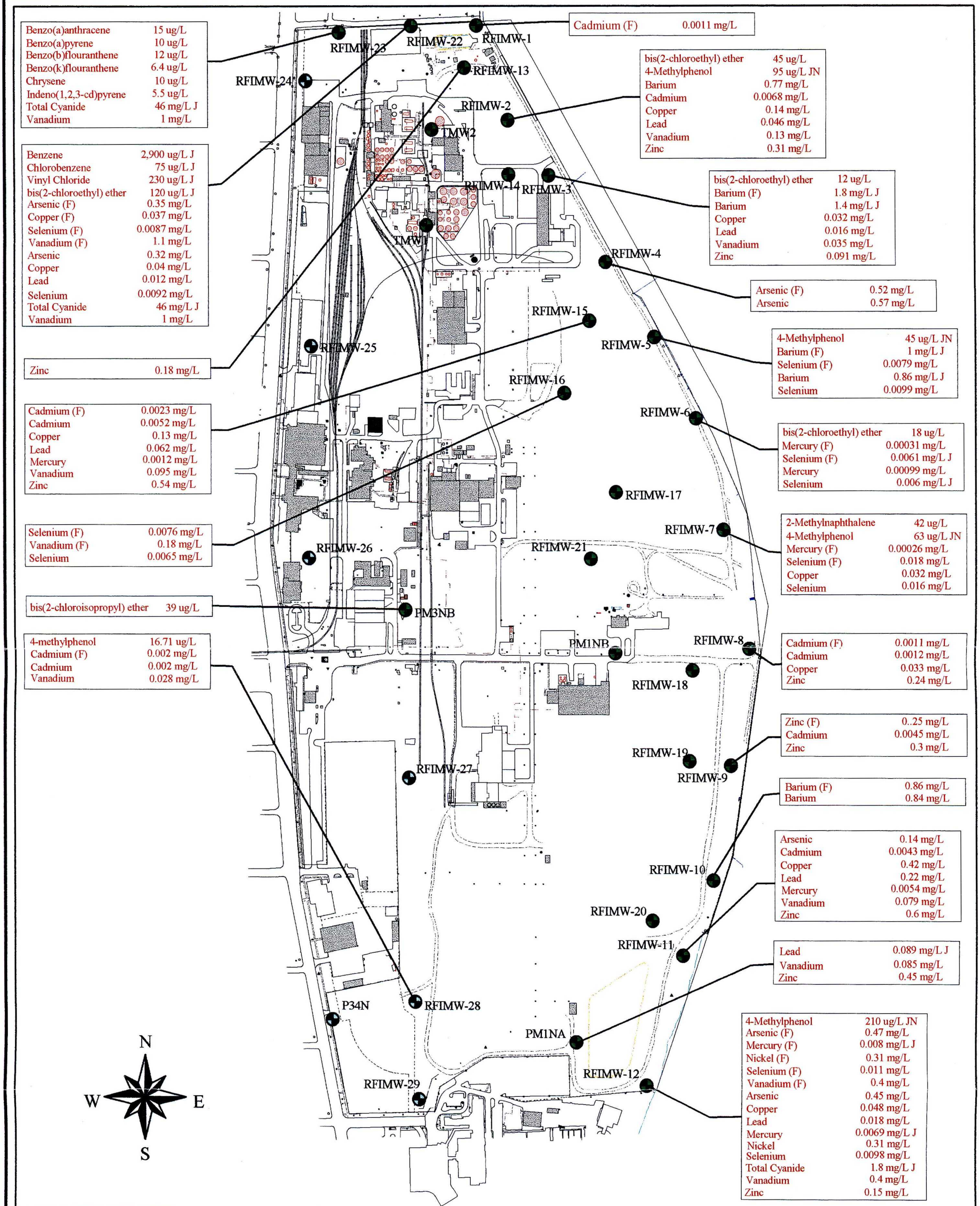
Figure 7-13. Potentiometric Groundwater Surface (March 1997)

QST ENVIRONMENTAL

BASF

RCRA Facility Investigation

Wyandotte, Michigan



LEGEND

- Existing Monitoring Well
- Background Monitoring Well
- Storage Tank
- Building/Structure
- Unpaved Road
- Fenceline

Notes:

1) Analytical groundwater concentrations in red print denote sampling results which exceeded PSAL levels.
2) Analytical groundwater results represent total concentrations unless otherwise indicated. Results for filtered constituents are designated with a (F).

500 0 500

Feet

1:6000

Revised: 02-26-99

Figure 7-29. Selected Groundwater Concentrations (1st Quarterly Event- September 1996)

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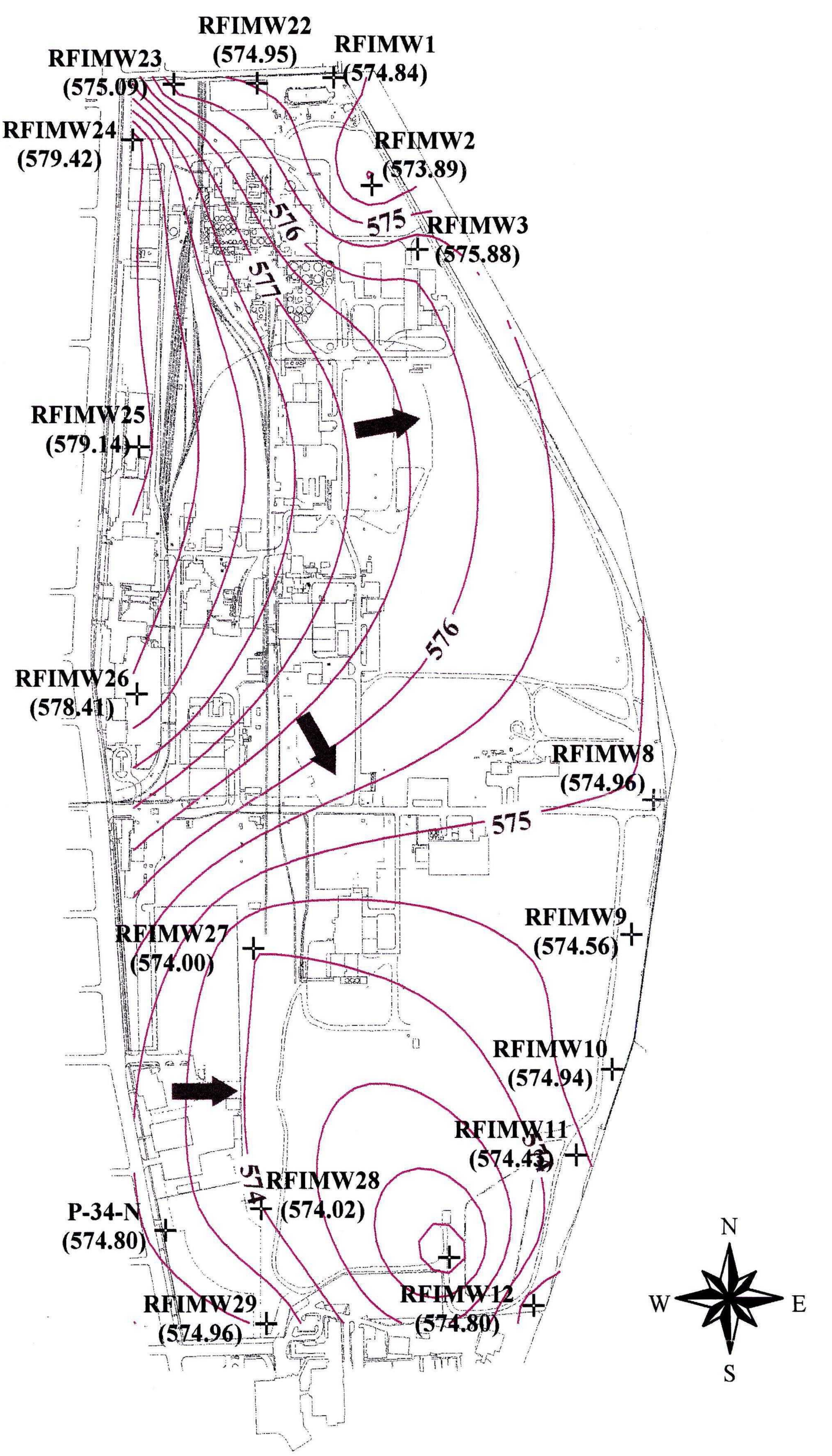
BASF

RCRA Facility Investigation

Wyandotte, Michigan



LEGEND

- Elevation contours
- Point of known elevation
- Apparent direction of groundwater flow

500 0 500

Feet

1:6500

Revised: 02-26-99

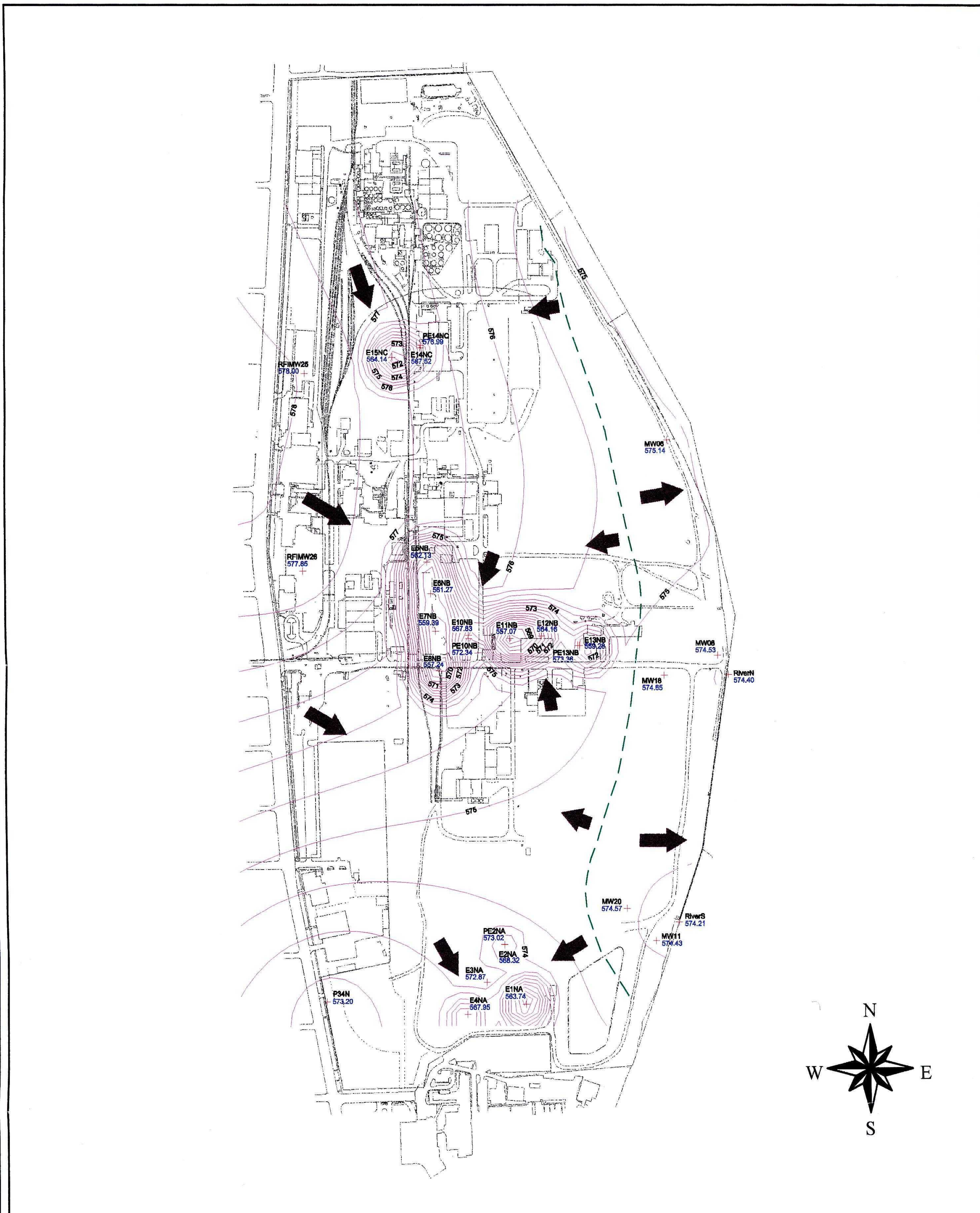
Figure 7-14. Potentiometric Groundwater Surface (June 1997)

QST ENVIRONMENTAL

BASF

RCRA Facility Investigation

Wyandotte, Michigan



LEGEND

- Elevation contours (0.5 feet)
- Point of known elevation
- Apparent direction of groundwater flow
- Estimated location of groundwater divide

500 0 500

Feet

1:6500

Revised: 02-26-99

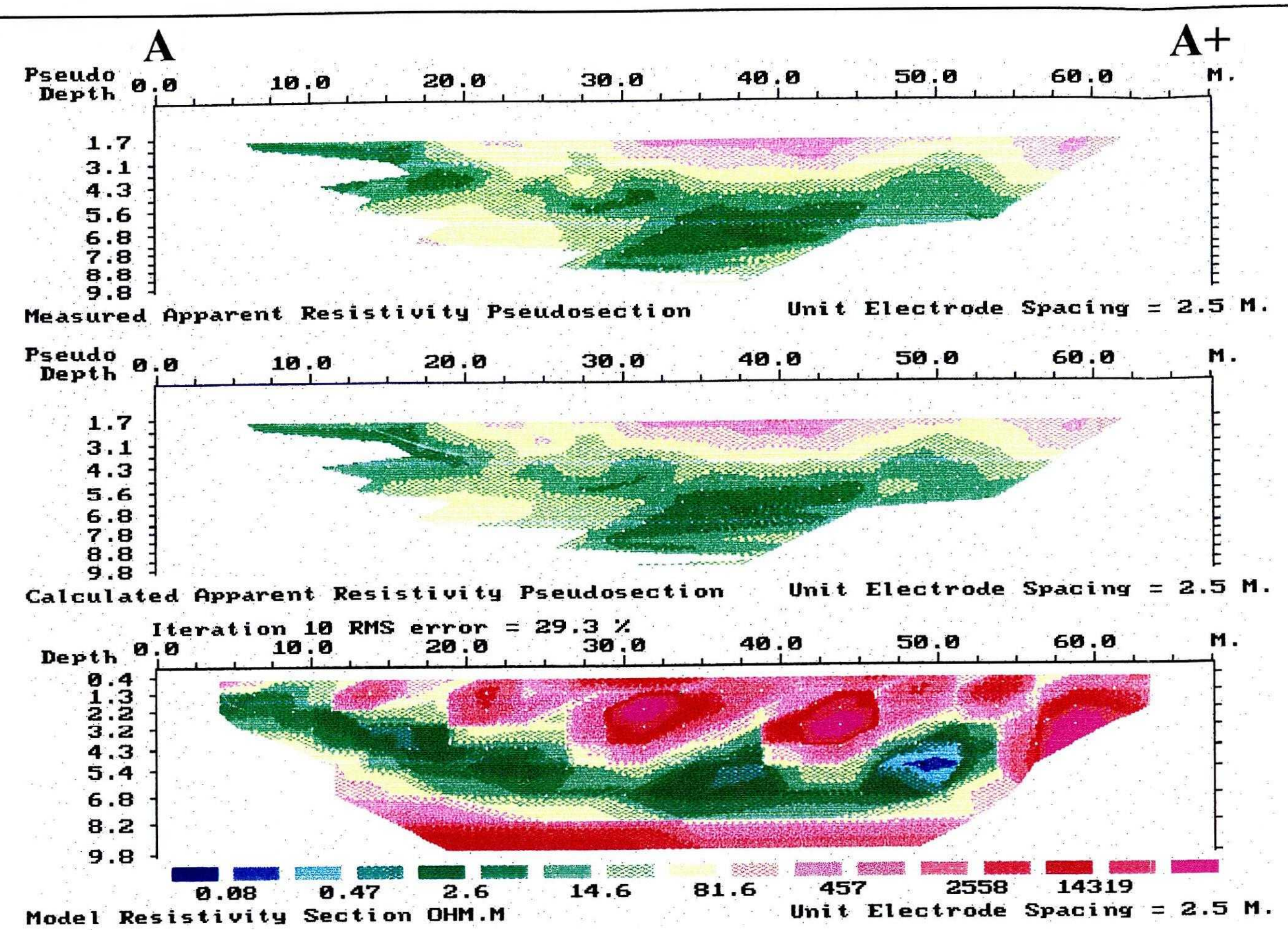
Figure 7-15. Approximation of Potentiometric Surface for August 10, 1997

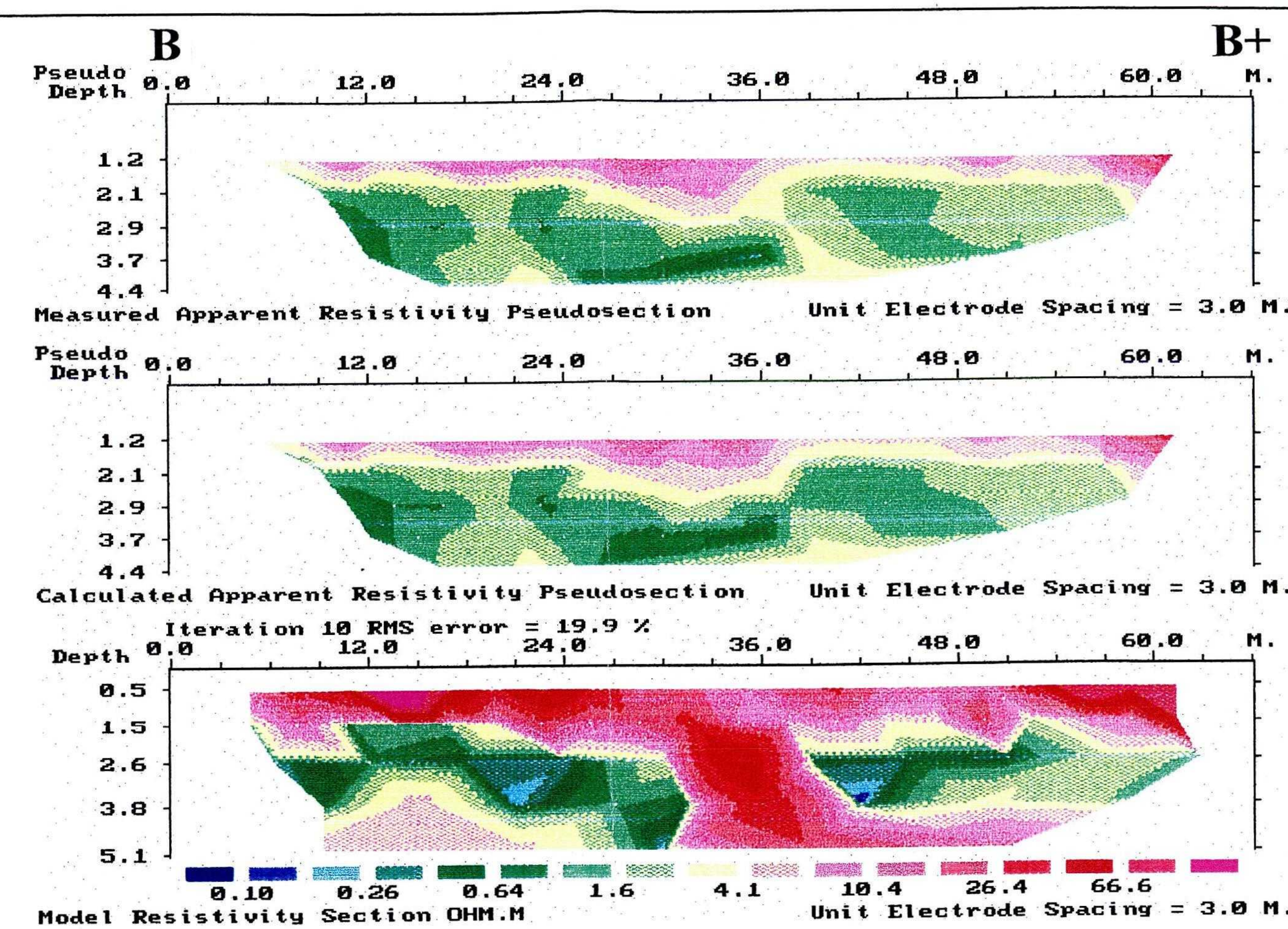
QST ENVIRONMENTAL

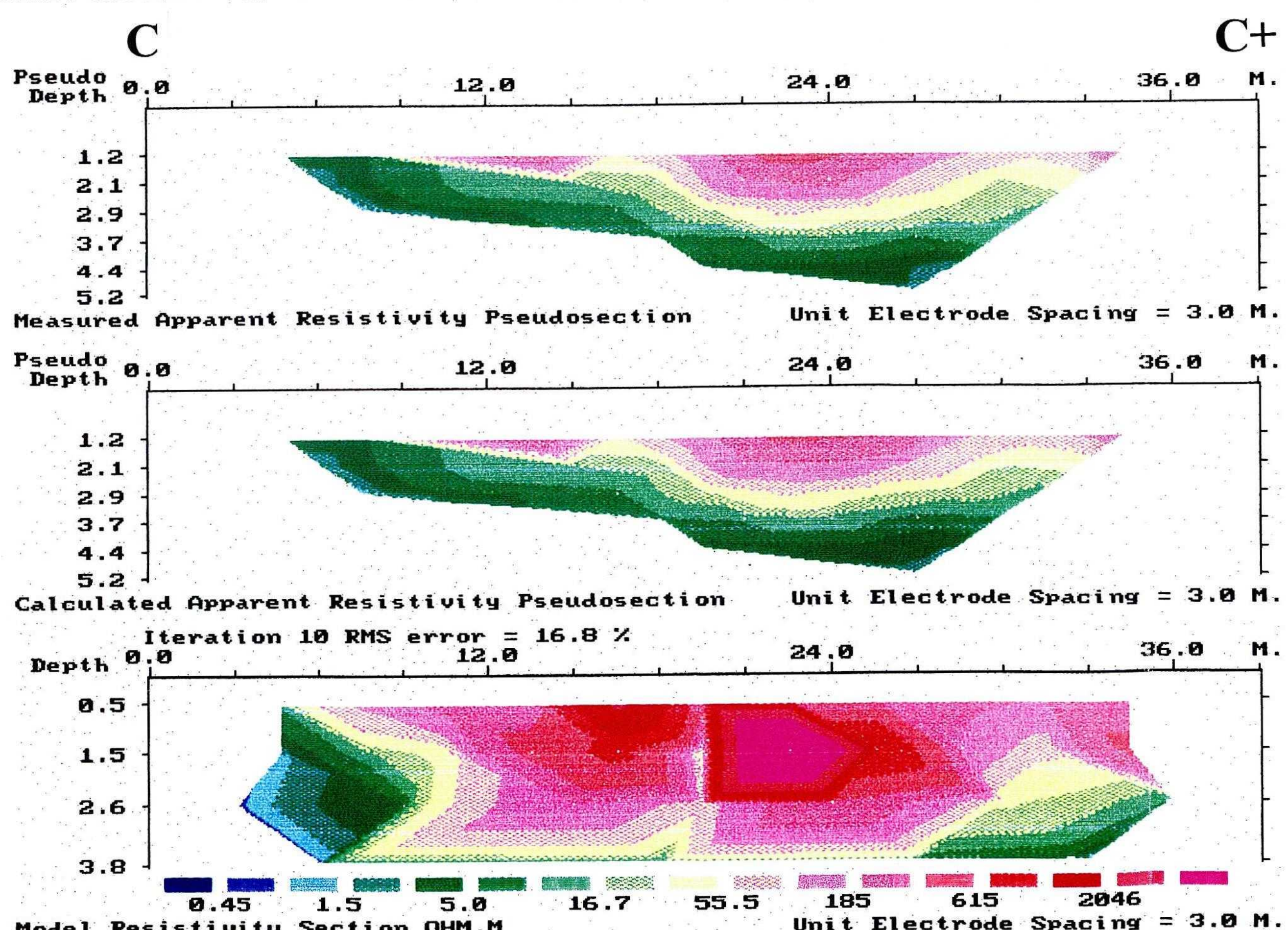
BASF

RCRA Facility Investigation

Wyandotte, Michigan

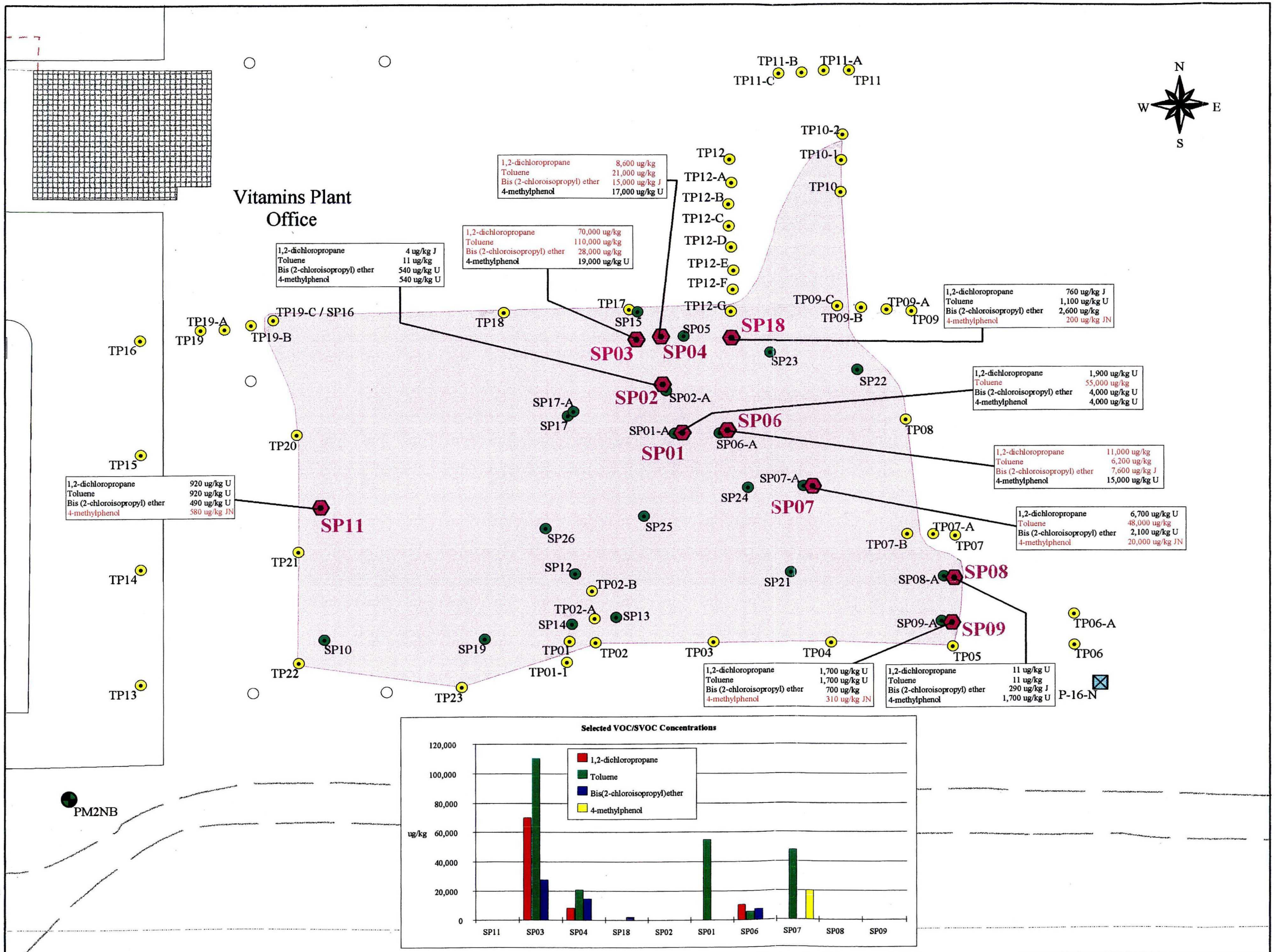






QST ENVIRONMENTAL

Figure 7-16
Resistivity Profiles
For Aoc 4
BASF-Wyandotte
RFI Report



BASF

RCRA Facility Investigation

Wyandotte, Michigan

LEGEND

- SWMU F Approximate Delineation
- Soil Sampling Location
- Perimeter Soil Boring Location
- Interior Soil Boring Location
- Existing Monitoring Well
- Piezometer
- Building/Structure
- Unpaved Road

Notes:

1) Samples collected for laboratory analysis were representative of SWMU F fill materials.
2) Analytical soil concentrations in red print denote sampling results which exceeded PSAL levels.
3) Bar chart concentrations are displayed for sampling locations generally progressing from west to east across SMWU F.

20 0 20 40

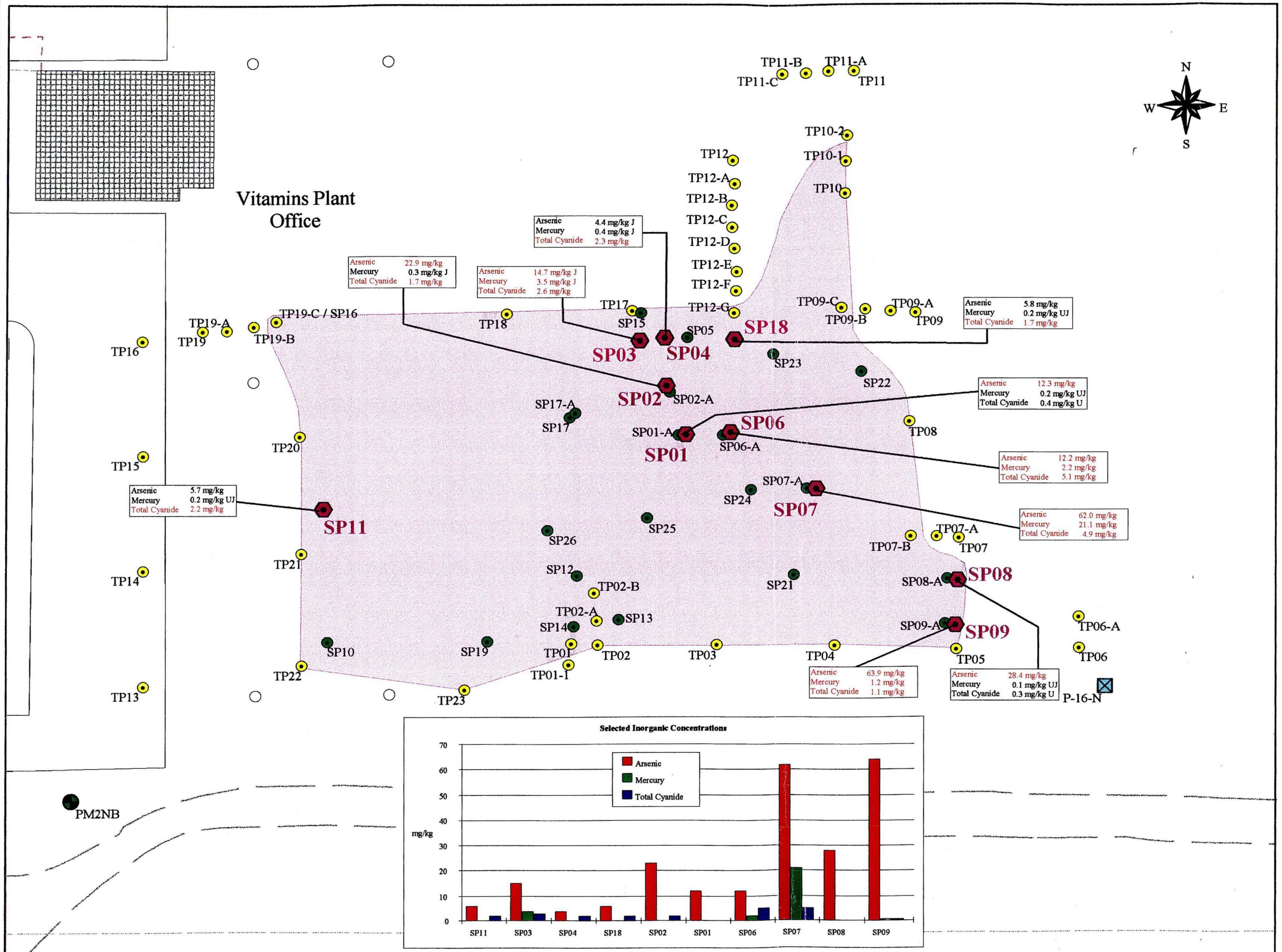
Feet

1:500

Revised: 02-26-99

Figure 7-17. Selected VOC / SVOC Concentrations for SWMU F Confirmatory Soil Borings

QST ENVIRONMENTAL



BASF

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Wyandotte, Michigan

LEGEND

- SWMU F Approximate Delineation
- Soil Sampling Location
- Perimeter Soil Boring Location
- Interior Soil Boring Location
- Existing Monitoring Well
- Piezometer
- Building/Structure
- Unpaved Road

Notes:

1) Samples collected for laboratory analysis were representative of SWMU F fill materials.
2) Analytical soil concentrations in red print denote sampling results which exceeded PSAL levels.
3) Bar chart concentrations are displayed for sampling locations generally progressing from west to east across SMWU F.

20 0 20 40 Feet

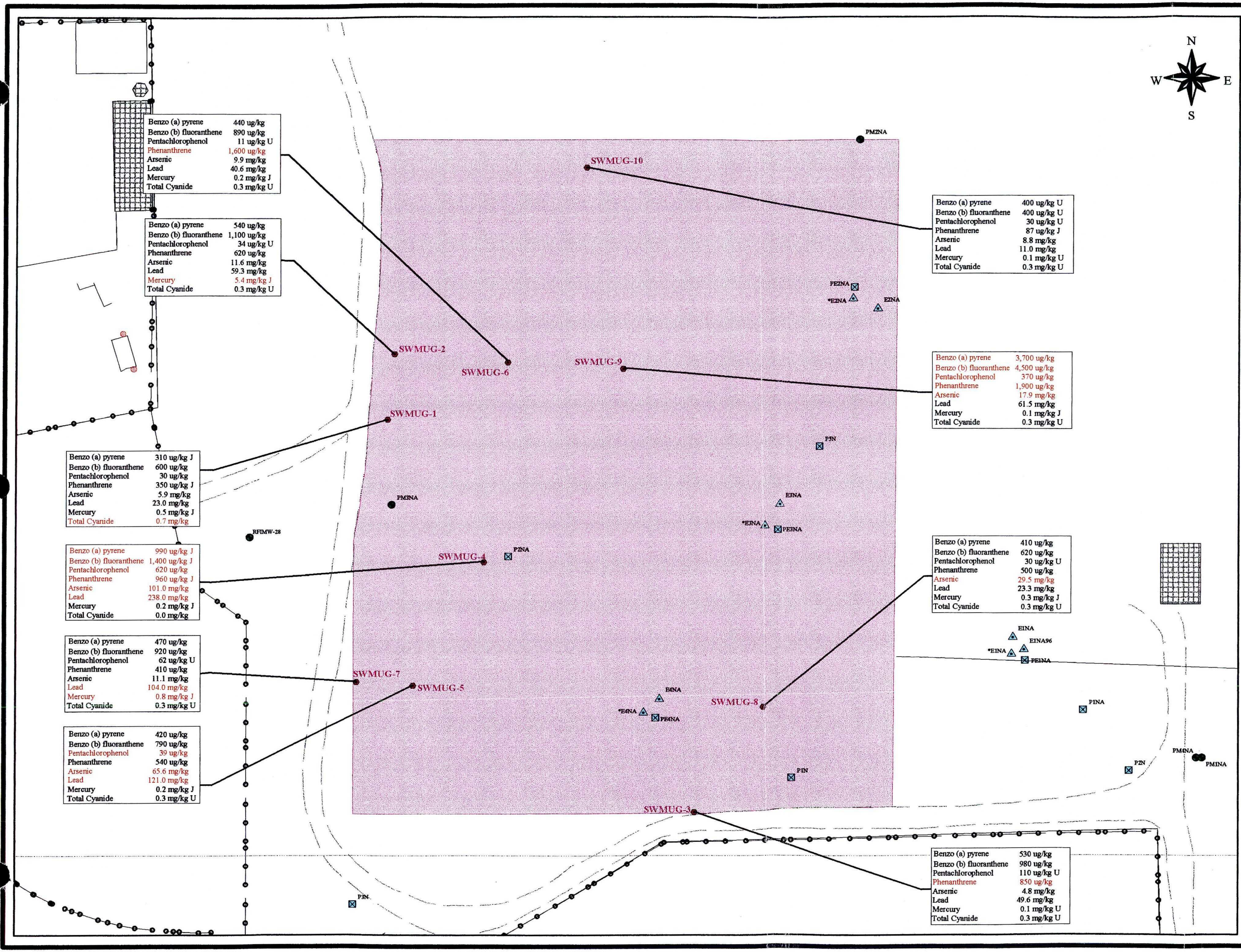
Feet

1:500

Revised: 02-26-99

Figure 7-18. Selected Inorganic Concentrations for SWMU F Confirmatory Soil Borings

QST ENVIRONMENTAL



BASF

RCRA Facility Investigation
Wyandotte, Michigan

LEGEND

SWMU G Approximate Delineation
Soil Sampling Location
Soil Boring Location
Piezometer Location
Existing Monitoring Well
Extraction Well
Building/Structure
Unpaved Road
Fenceline
Storage Tank

Notes:

1) Analytical soil concentrations in red print denote sampling results which exceeded PSAL levels.
2) Replacement wells/piezometers are labeled with an asterisk

50 0 50

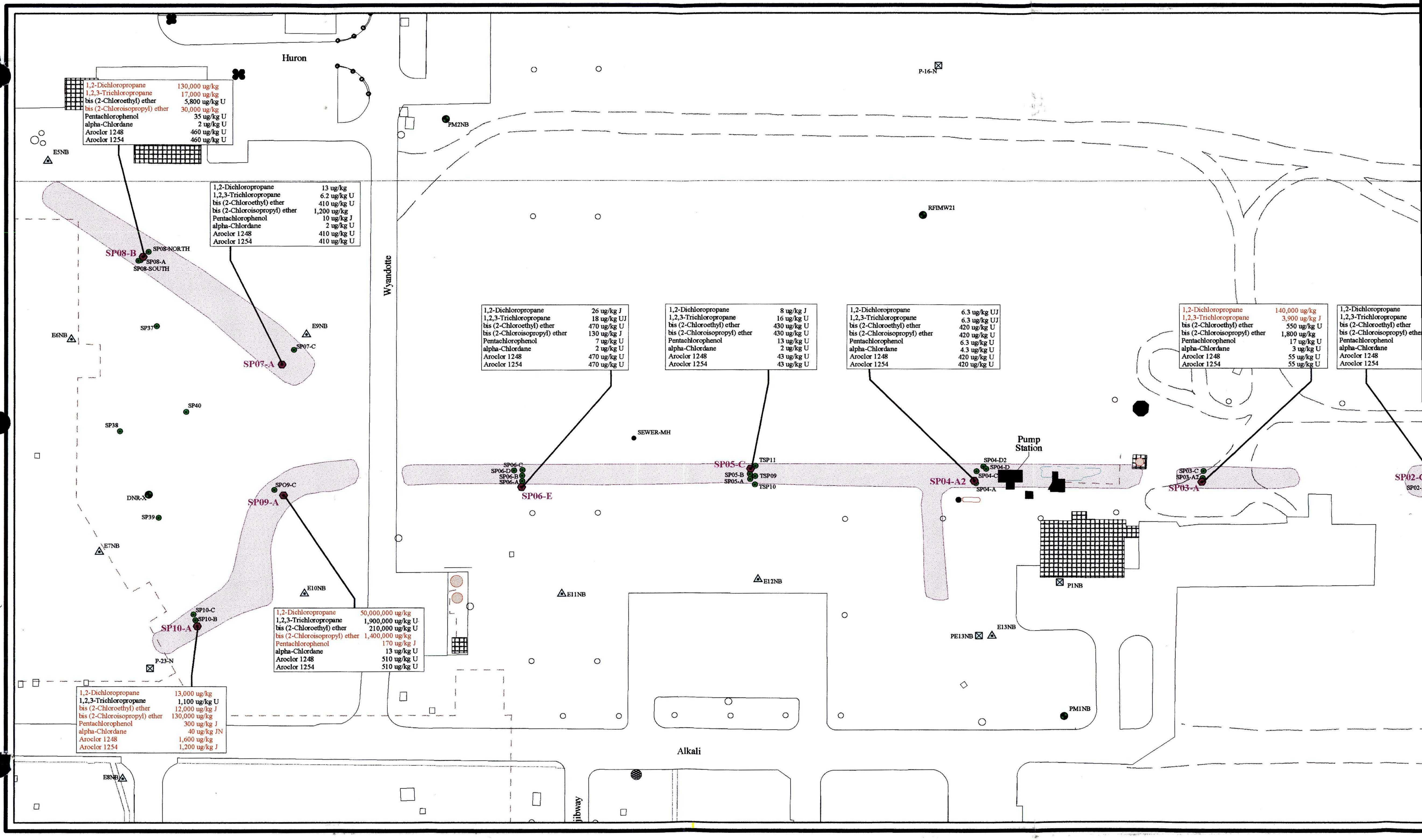
Feet

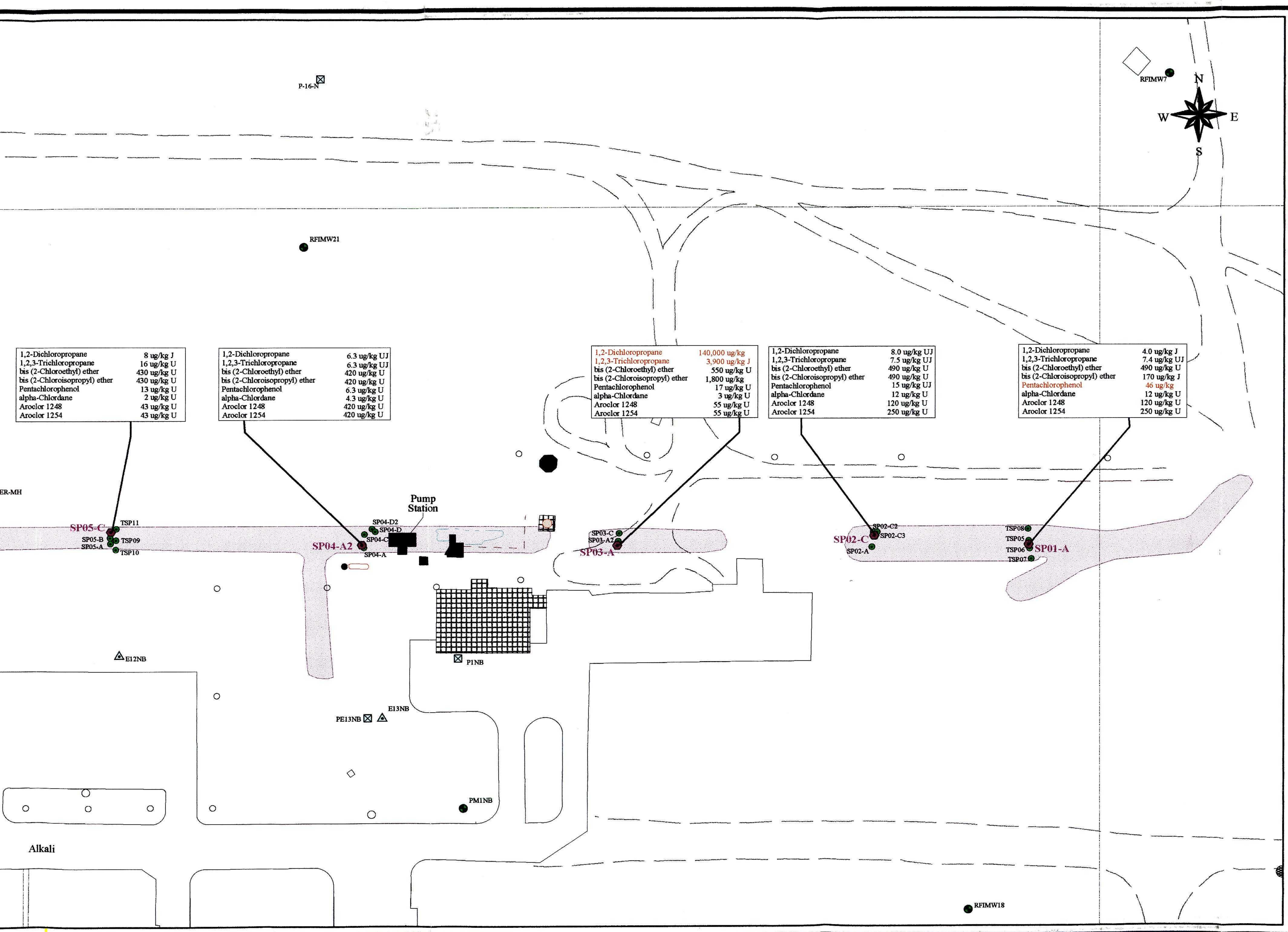
1:1,000

Revised: 02-26-99

Figure 7-19. Selected SVOC/Inorganic Concentrations for SWMU G Surface Soil Samples

QST ENVIRONMENTAL


Huron
Wyandotte
Alkali
Pump Station
P-16-N
PM2NB
RFIMW21
E5NB
E6NB
E7NB
E8NB
E9NB
E10NB
E11NB
E12NB
E13NB
PE13NB
P1NB
PM1NB
P-23-N
SEWER-MH
SP37
SP38
SP39
SP40
DNR-X
SP08-B
SP08-NORTH
SP08-A
SP08-SOUTH
SP07-A
SP07-C
SP09-A
SP09-C
SP10-A
SP10-C
SP10-B
SP06-E
SP06-C
SP06-D
SP06-B
SP06-A
SP05-C
SP05-B
SP05-A
TSP11
TSP09
TSP10
SP04-A2
SP04-D2
SP04-D
SP04-C
SP04-A
SP03-A
SP03-C
SP03-A2
1,2-Dichloropropane 130,000 ug/kg
1,2,3-Trichloropropane 17,000 ug/kg
bis (2-Chloroethyl) ether 5,800 ug/kg U
bis (2-Chloroisopropyl) ether 30,000 ug/kg
Pentachlorophenol 35 ug/kg U
alpha-Chlordane 2 ug/kg U
Aroclor 1248 460 ug/kg U
Aroclor 1254 460 ug/kg U
1,2-Dichloropropane 13 ug/kg
1,2,3-Trichloropropane 6.2 ug/kg U
bis (2-Chloroethyl) ether 410 ug/kg U
bis (2-Chloroisopropyl) ether 1,200 ug/kg
Pentachlorophenol 10 ug/kg J
alpha-Chlordane 2 ug/kg U
Aroclor 1248 410 ug/kg U
Aroclor 1254 410 ug/kg U
1,2-Dichloropropane 26 ug/kg J
1,2,3-Trichloropropane 18 ug/kg UJ
bis (2-Chloroethyl) ether 470 ug/kg U
bis (2-Chloroisopropyl) ether 130 ug/kg J
Pentachlorophenol 7 ug/kg U
alpha-Chlordane 2 ug/kg U
Aroclor 1248 470 ug/kg U
Aroclor 1254 470 ug/kg U
1,2-Dichloropropane 8 ug/kg J
1,2,3-Trichloropropane 16 ug/kg U
bis (2-Chloroethyl) ether 430 ug/kg U
bis (2-Chloroisopropyl) ether 430 ug/kg U
Pentachlorophenol 13 ug/kg U
alpha-Chlordane 2 ug/kg U
Aroclor 1248 43 ug/kg U
Aroclor 1254 43 ug/kg U
1,2-Dichloropropane 6.3 ug/kg UJ
1,2,3-Trichloropropane 6.3 ug/kg UJ
bis (2-Chloroethyl) ether 420 ug/kg U
bis (2-Chloroisopropyl) ether 420 ug/kg U
Pentachlorophenol 6.3 ug/kg U
alpha-Chlordane 4.3 ug/kg U
Aroclor 1248 420 ug/kg U
Aroclor 1254 420 ug/kg U
1,2-Dichloropropane 140,000 ug/kg
1,2,3-Trichloropropane 3,900 ug/kg J
bis (2-Chloroethyl) ether 550 ug/kg U
bis (2-Chloroisopropyl) ether 1,800 ug/kg
Pentachlorophenol 17 ug/kg U
alpha-Chlordane 3 ug/kg U
Aroclor 1248 55 ug/kg U
Aroclor 1254 55 ug/kg U
1,2-Dichloropropane
1,2,3-Trichloropropane
bis (2-Chloroethyl) ether
bis (2-Chloroisopropyl) ether
Pentachlorophenol
alpha-Chlordane
Aroclor 1248
Aroclor 1254
1,2-Dichloropropane 50,000,000 ug/kg
1,2,3-Trichloropropane 1,900,000 ug/kg U
bis (2-Chloroethyl) ether 210,000 ug/kg U
bis (2-Chloroisopropyl) ether 1,400,000 ug/kg
Pentachlorophenol 170 ug/kg J
alpha-Chlordane 13 ug/kg U
Aroclor 1248 510 ug/kg U
Aroclor 1254 510 ug/kg U
1,2-Dichloropropane 13,000 ug/kg
1,2,3-Trichloropropane 1,100 ug/kg U
bis (2-Chloroethyl) ether 12,000 ug/kg J
bis (2-Chloroisopropyl) ether 130,000 ug/kg
Pentachlorophenol 300 ug/kg J
alpha-Chlordane 40 ug/kg JN
Aroclor 1248 1,600 ug/kg
Aroclor 1254 1,200 ug/kg J



BASF

RCRA Facility Investigation
Wyandotte, Michigan

LEGEND

- SWMU H Approximate Delineation
- Soil Sampling Location
- Soil Boring Location
- Piezometer Location
- Extraction Well
- Storage Tank
- Building/Structure
- Overhead Piping
- Unpaved Road

Notes:

1) Approximate delineation of SWMU H was determined using both visual soil boring results and historic maps/drawings of the trench routing.
2) Analytical soil concentrations in red print denote sampling results which exceeded PSAL levels.

50 0 50

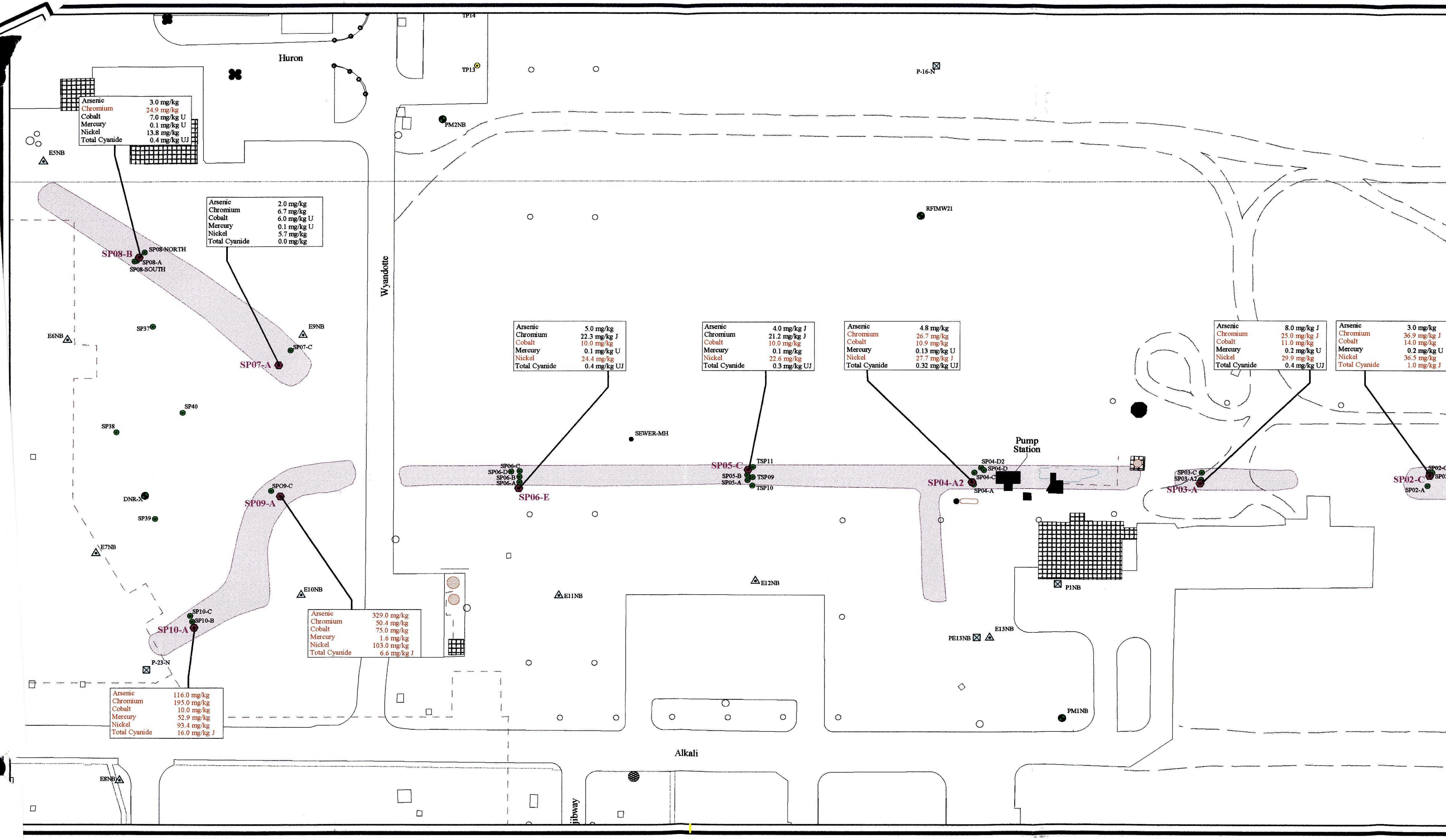
Feet

1:900

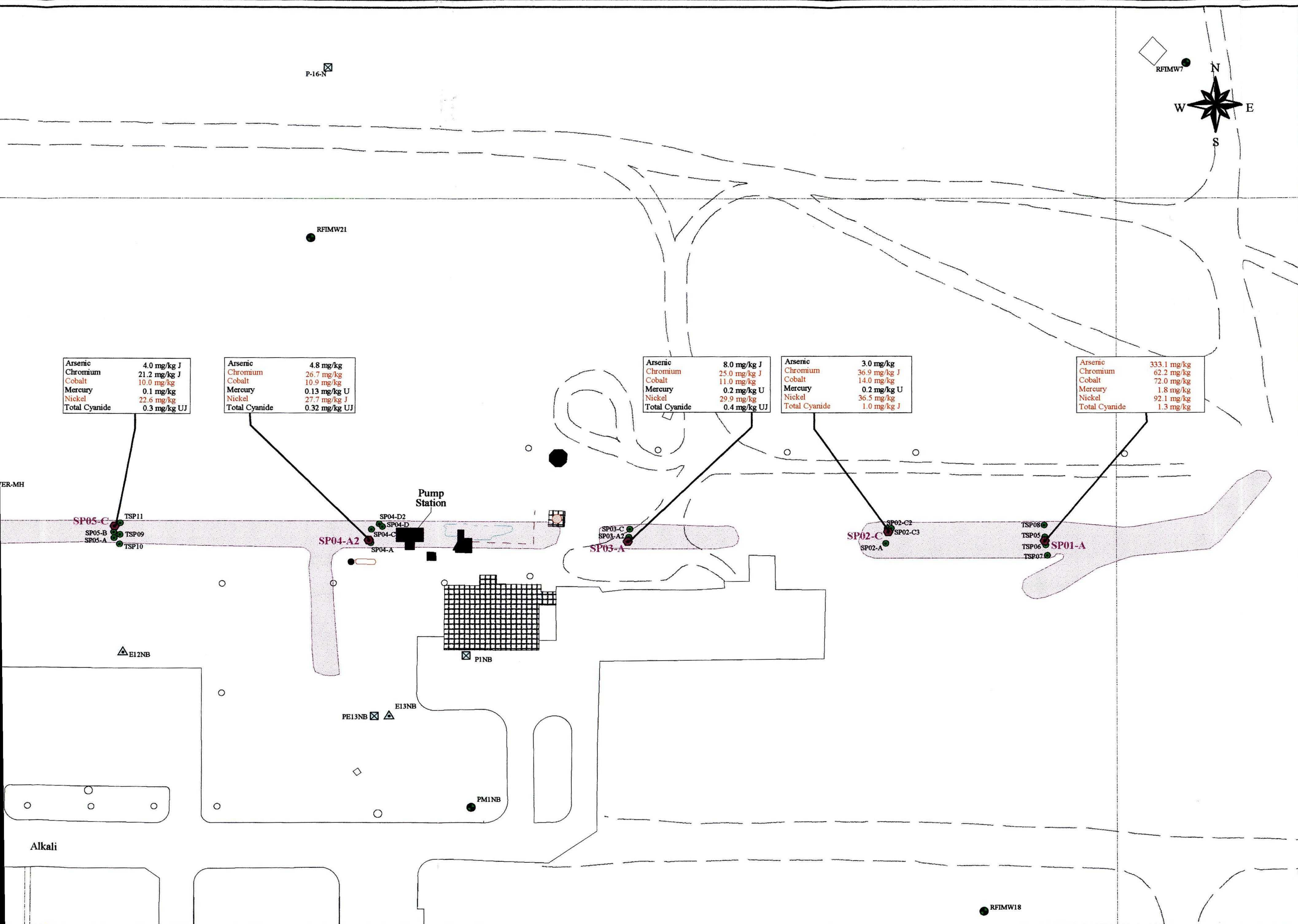
Revised: 02-26-99

Figure 7-20.
Selected VOC/SVOC/Pesticide Concentrations for SWMU H Confirmatory Soil Borings

QST ENVIRONMENTAL



Huron
TP14
TP13
P-16-N
PM2NB
E5NB
Arsenic 3.0 mg/kg
Chromium 24.9 mg/kg
Cobalt 7.0 mg/kg U
Mercury 0.1 mg/kg U
Nickel 13.8 mg/kg
Total Cyanide 0.4 mg/kg UJ
Arsenic 2.0 mg/kg
Chromium 6.7 mg/kg
Cobalt 6.0 mg/kg U
Mercury 0.1 mg/kg U
Nickel 5.7 mg/kg
Total Cyanide 0.0 mg/kg
RFIMW21
SP08-B
SP08-NORTH
SP08-A
SP08-SOUTH
Wyandotte
E9NB
E6NB
SP37
SP07-C
SP07-A
Arsenic 5.0 mg/kg
Chromium 22.3 mg/kg J
Cobalt 10.0 mg/kg
Mercury 0.1 mg/kg U
Nickel 24.4 mg/kg
Total Cyanide 0.4 mg/kg UJ
Arsenic 4.0 mg/kg J
Chromium 21.2 mg/kg J
Cobalt 10.0 mg/kg
Mercury 0.1 mg/kg
Nickel 22.6 mg/kg
Total Cyanide 0.3 mg/kg UJ
Arsenic 4.8 mg/kg
Chromium 26.7 mg/kg
Cobalt 10.9 mg/kg
Mercury 0.13 mg/kg U
Nickel 27.7 mg/kg J
Total Cyanide 0.32 mg/kg UJ
Arsenic 8.0 mg/kg J
Chromium 25.0 mg/kg J
Cobalt 11.0 mg/kg
Mercury 0.2 mg/kg U
Nickel 29.9 mg/kg
Total Cyanide 0.4 mg/kg UJ
Arsenic 3.0 mg/kg
Chromium 36.9 mg/kg J
Cobalt 14.0 mg/kg
Mercury 0.2 mg/kg U
Nickel 36.5 mg/kg
Total Cyanide 1.0 mg/kg J
SP40
SP38
SEWER-MH
Pump Station
SP06-C
SP06-D
SP06-B
SP06-A
SP06-E
SP05-C
TSP11
SP05-B
SP05-A
TSP09
TSP10
SP04-D2
SP04-D
SP04-C
SP04-A2
SP04-A
SP03-C
SP03-A2
SP03-A
SP02-C
SP02-A
SP09-C
SP09-A
DNR-X
SP39
E7NB
E10NB
E11NB
E12NB
P1NB
E13NB
PE13NB
SP10-C
SP10-B
SP10-A
P-23-N
Arsenic 329.0 mg/kg
Chromium 50.4 mg/kg
Cobalt 75.0 mg/kg
Mercury 1.6 mg/kg
Nickel 103.0 mg/kg
Total Cyanide 6.6 mg/kg J
Arsenic 116.0 mg/kg
Chromium 195.0 mg/kg
Cobalt 10.0 mg/kg
Mercury 52.9 mg/kg
Nickel 93.4 mg/kg
Total Cyanide 16.0 mg/kg J
PM1NB
Alkali
E8NB
jibway



BASF

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Wyandotte, Michigan

LEGEND

- SWMU H Approximate Delineation
- Soil Sampling Location
- Soil Boring Location
- Piezometer Location
- Extraction Well
- Storage Tank
- Building/Structure
- Overhead Piping
- Unpaved Road

Notes:

1) Approximate delineation of SWMU H was determined using both visual soil boring results and historic maps/drawings of the trench routing.
2) Analytical soil concentrations in red print denote sampling results which exceeded PSAL levels.

50 0 50

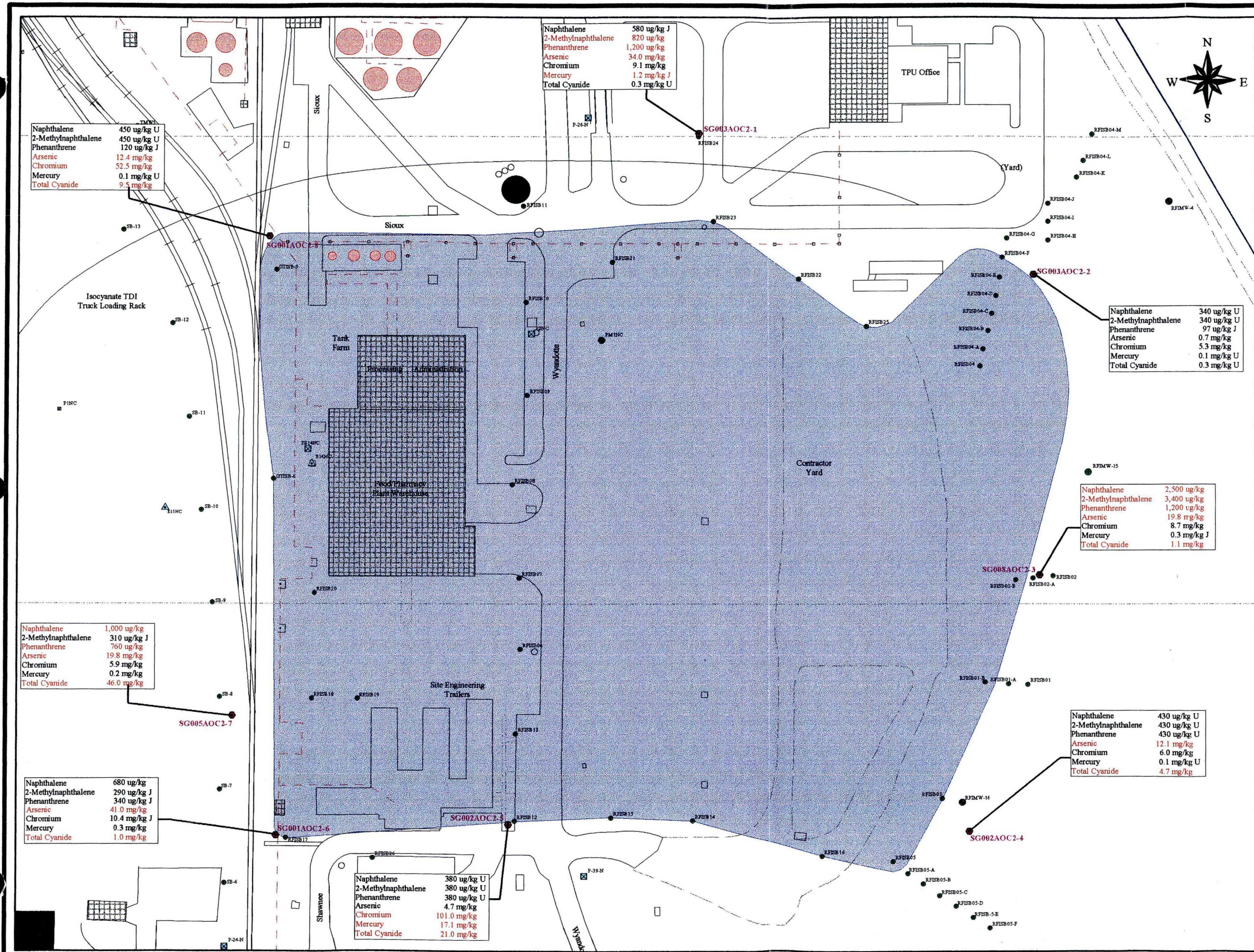
Feet

1:900

Revised: 02-26-99

Figure 7-21. Selected Inorganic Concentrations for SWMU H Confirmatory Soil Borings

QST ENVIRONMENTAL



BASF

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Wyandotte, Michigan

LEGEND

- AOC 2 Approximate Delineation
- Soil Sampling Location
- Soil Boring Location
- Soil Boring Location/Monitoring Well
- Existing Monitoring Well
- Piezometer Location
- Extraction Well
- Building/Structure
- Unpaved Road
- Storage Tank
- Overhead Piping

Notes:

1) Samples collected for laboratory analysis were representative of AOC 2 fill materials.

2) Analytical soil concentrations in red print denote sampling results which exceeded PSAL levels.

50 0 50 100

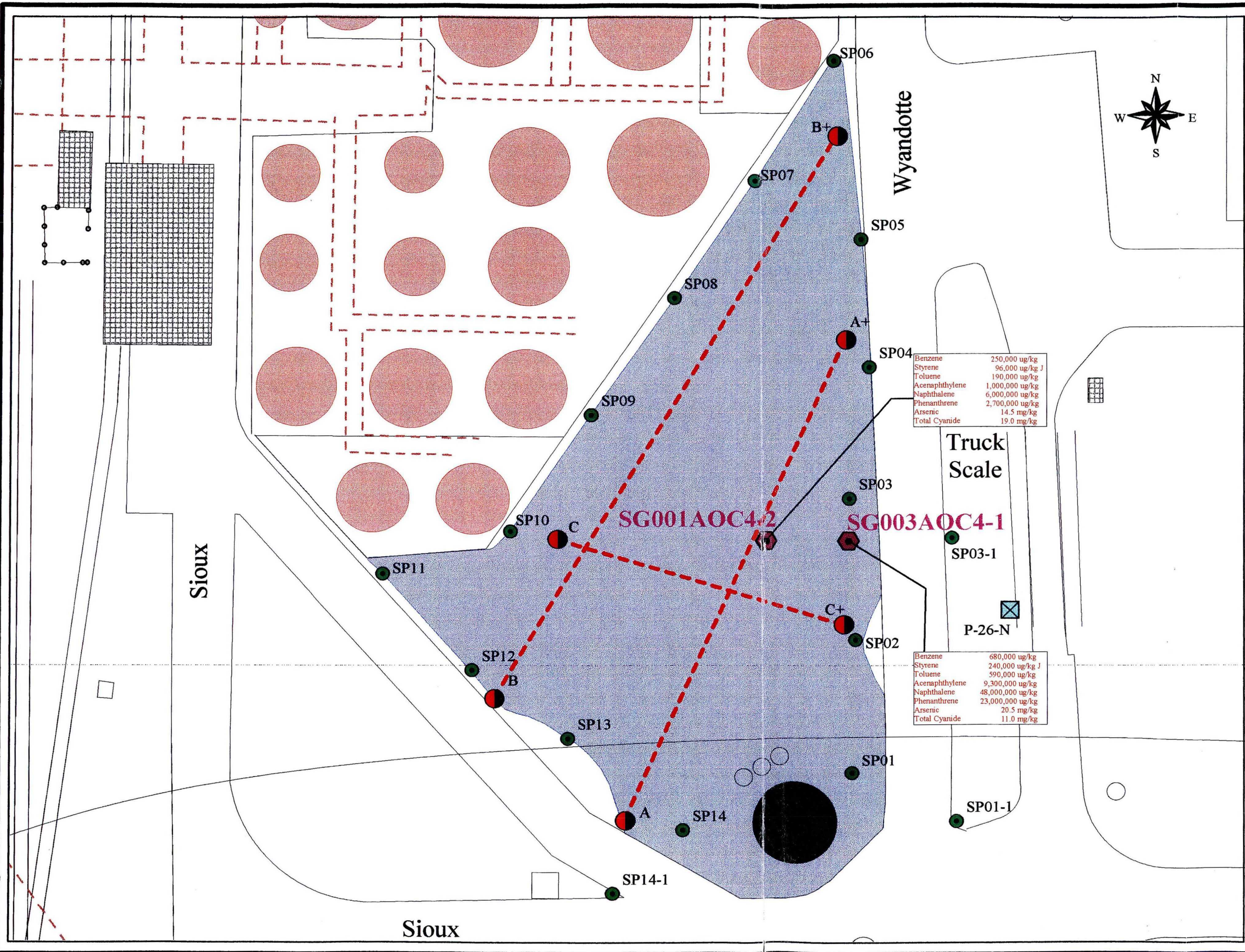
Feet

1:1,200

Revised: 02-26-99

Figure 7-22. Selected SVOC/Inorganic Concentrations for AOC 2 Confirmatory Soil Borings

QST ENVIRONMENTAL



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RCRA Facility Investigation
Wyandotte, Michigan

LEGEND

- AOC 4 Approximate Delineation
- Soil Sampling Location
- Soil Boring Location
- Resistivity Survey Transect
- Piezometer Location
- Building/Structure
- Storage Tank
- Overhead Piping

Notes:

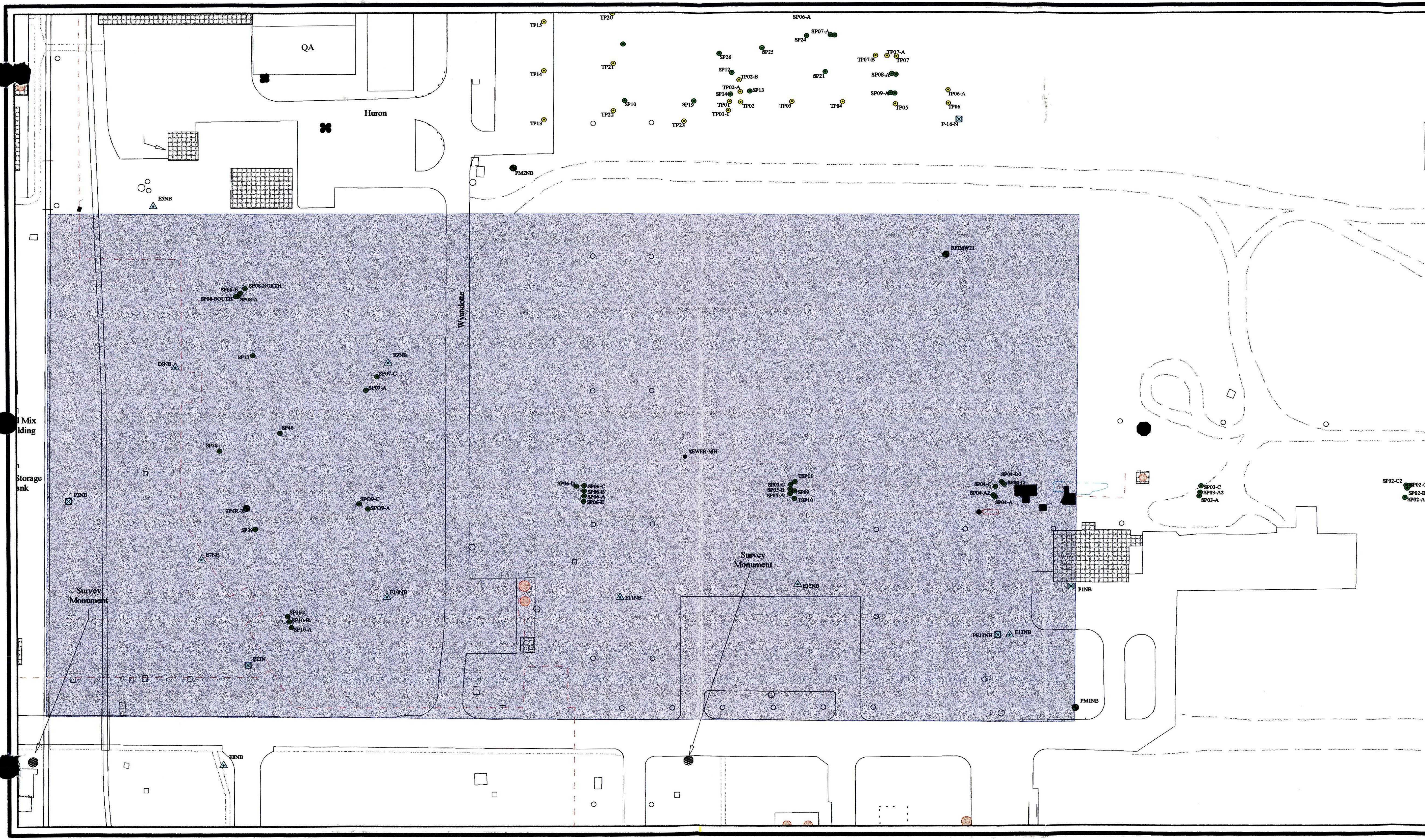
1) Samples collected for laboratory analysis were representative of AOC 4 fill materials.
2) Analytical soil concentrations in red print denote sampling results which exceeded PSAL levels.

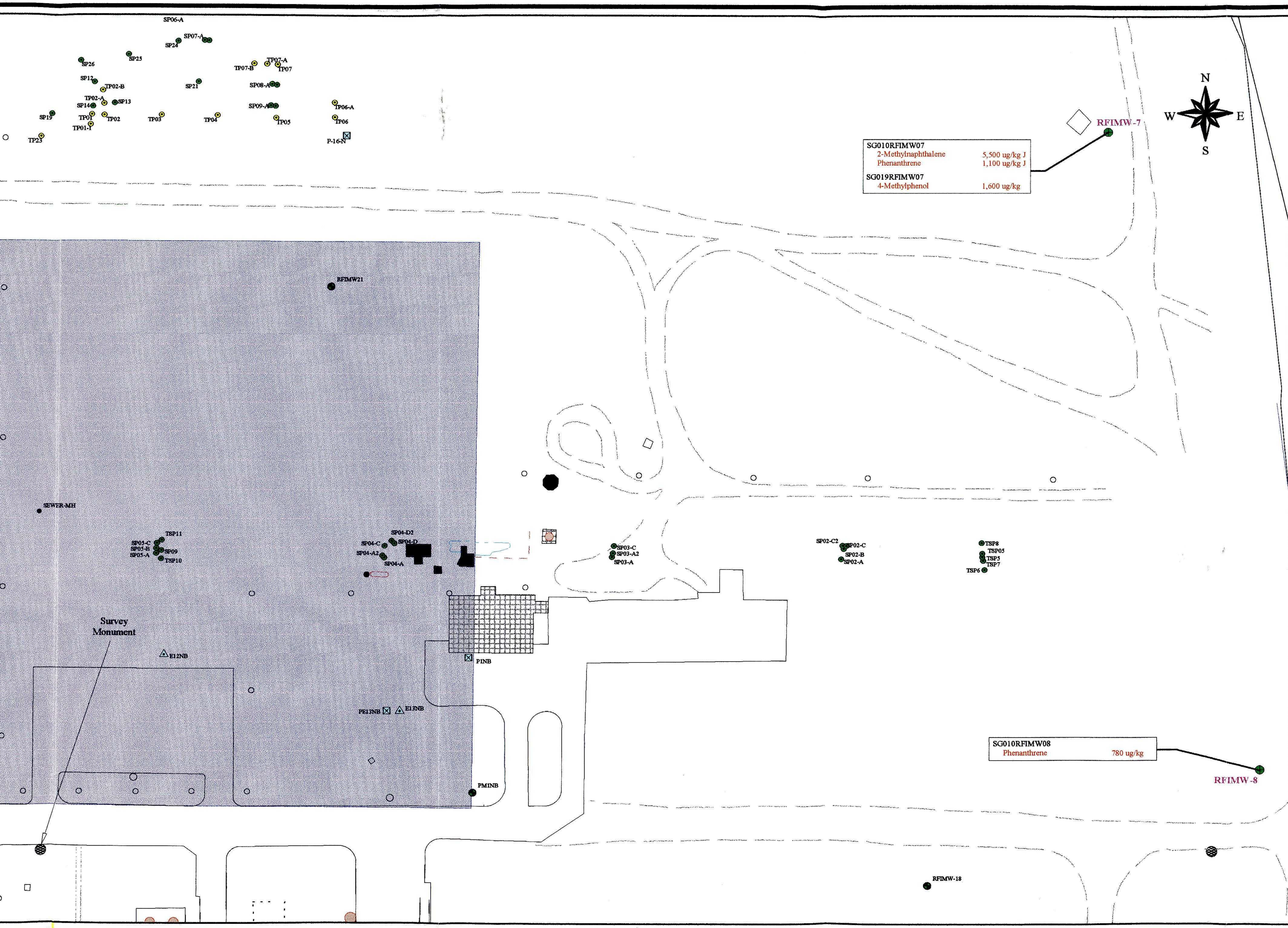
20 0 20 40
Feet
1:400

Revised: 02-26-99

Figure 7-23. Selected VOC/SVOC/Inorganic Concentrations for Confirmatory Soil Borings and Resistivity Survey Transects at AOC 4

QST ENVIRONMENTAL


QA
Huron
Wyandotte
Survey Monument
Survey Monument
Mix
lding
Storage
ank
E5NB
E6NB
E9NB
E7NB
E10NB
E11NB
E12NB
E13NB
E8NB
PM2NB
PMINB
P1NB
P3NB
P22N
PE13NB
P-16-N
RFIMW21
SEWER-MH
DNR-X
SP08-NORTH
SP08-SOUTH
SP08-A
SP08-B
SP37
SP40
SP38
SP39
SP07-C
SP07-A
SP09-C
SP09-A
SP10-C
SP10-B
SP10-A
SP06-D
SP06-C
SP06-B
SP06-A
SP06-E
TSP11
SP05-C
SP05-B
SP05-A
SP09
TSP10
SP04-D2
SP04-C
SP04-D
SP04-A2
SP04-A
SP03-C
SP03-A2
SP03-A
SP02-C2
SP02-C
SP02-B
SP02-A
TP20
TP15
TP14
TP13
TP21
TP22
TP23
SP26
SP25
SP24
SP12
SP14
SP13
SP10
SP19
SP21
TP02-B
TP02-A
TP01
TP01-1
TP02
TP03
TP04
TP05
TP06
TP06-A
TP07-A
TP07-B
TP07
SP06-A
SP07-A
SP08-A
SP09-A



BASF

RCRA Facility Investigation
Wyandotte, Michigan

LEGEND

- AOC 5 Approximate Delineation
- Soil Sampling Location/ Monitoring Well
- Soil Boring Location
- Piezometer Location
- Extraction Well
- Storage Tank
- Building/Structure
- Overhead Piping
- Unpaved Road

Notes:

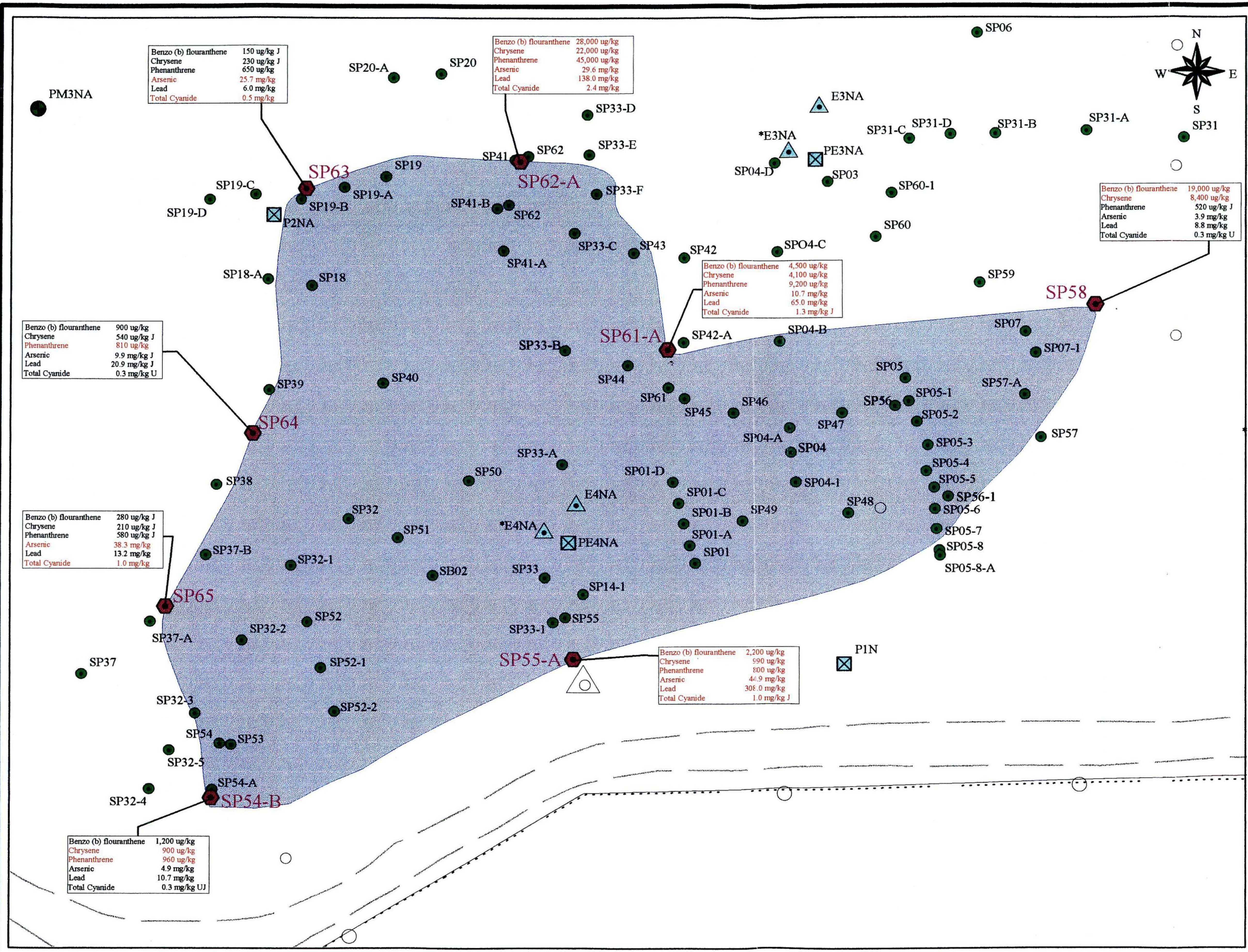
1) Surrounding soil borings were completed as part of the investigation for SWMU H.
2) Analytical soil concentrations in red print denote sampling results which exceeded PSAL levels.

50 0 50
Feet
1:1000

Revised: 02-26-99

Figure 7-24.
Selected SVOC Concentrations for AOC 5 Confirmatory Soil Borings

QST ENVIRONMENTAL



BASF

RCRA Facility Investigation
Wyandotte, Michigan

LEGEND

- AOC 6 Approximate Delineation
- Soil Sampling Location
- Soil Boring Location
- Existing Monitoring Well
- Piezometer Location
- Extraction Well
- Unpaved Road
- Fenceline

Notes:

1) Samples collected for laboratory analysis were representative of AOC 6 fill materials.
2) Analytical soil concentrations in red print denote sampling results which exceeded PSAL levels.
3) Replacement wells/piezometers are labeled with an asterisk.

30 0 30 60

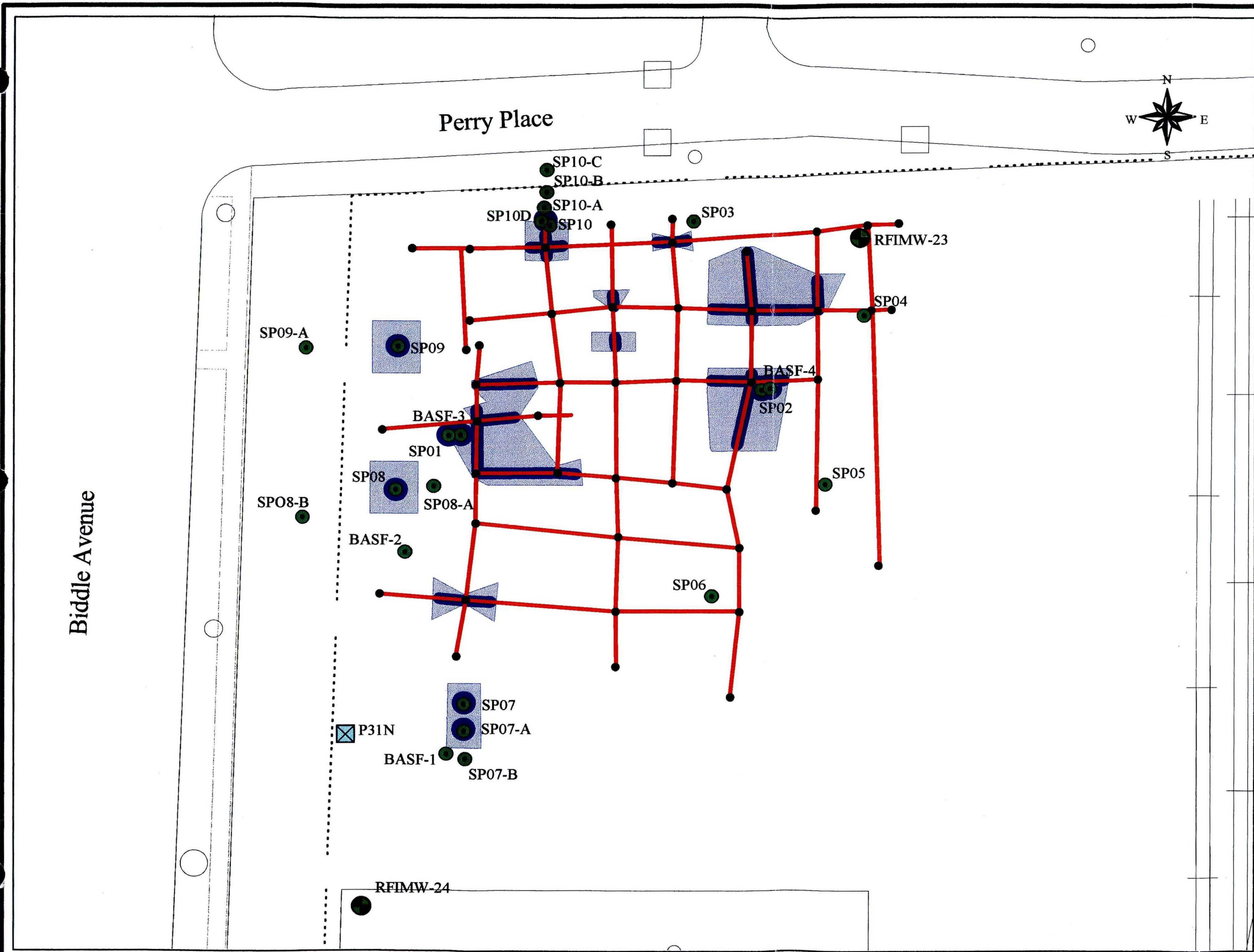
Feet

1:500

Revised: 02-26-99

Figure 7-25. Selected SVOC/Inorganic Concentrations for AOC 6 Confirmatory Soil Borings

QST ENVIRONMENTAL



BASF

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Wyandotte, Michigan

LEGEND

- AOC 7A Approximate Delineation
- Confirmed Boring or Surficial Locations of Prussian Blue
- Confirmed Trench Locations of Prussian Blue
- Perimeter Assessment Trenches
- Soil Boring Location
- Existing Monitoring Well
- Piezometer Location
- Fenceline

Notes:

1) Soil borings BASF-1 through BASF-4 were completed during a 1994 EPA limited investigation

2) Soil boring SP10-D represents a duplicate sampling location of SP10; Prussian Blue was encountered at SP10-D, but not at SP10.

10 0 10 20

Feet

1:400

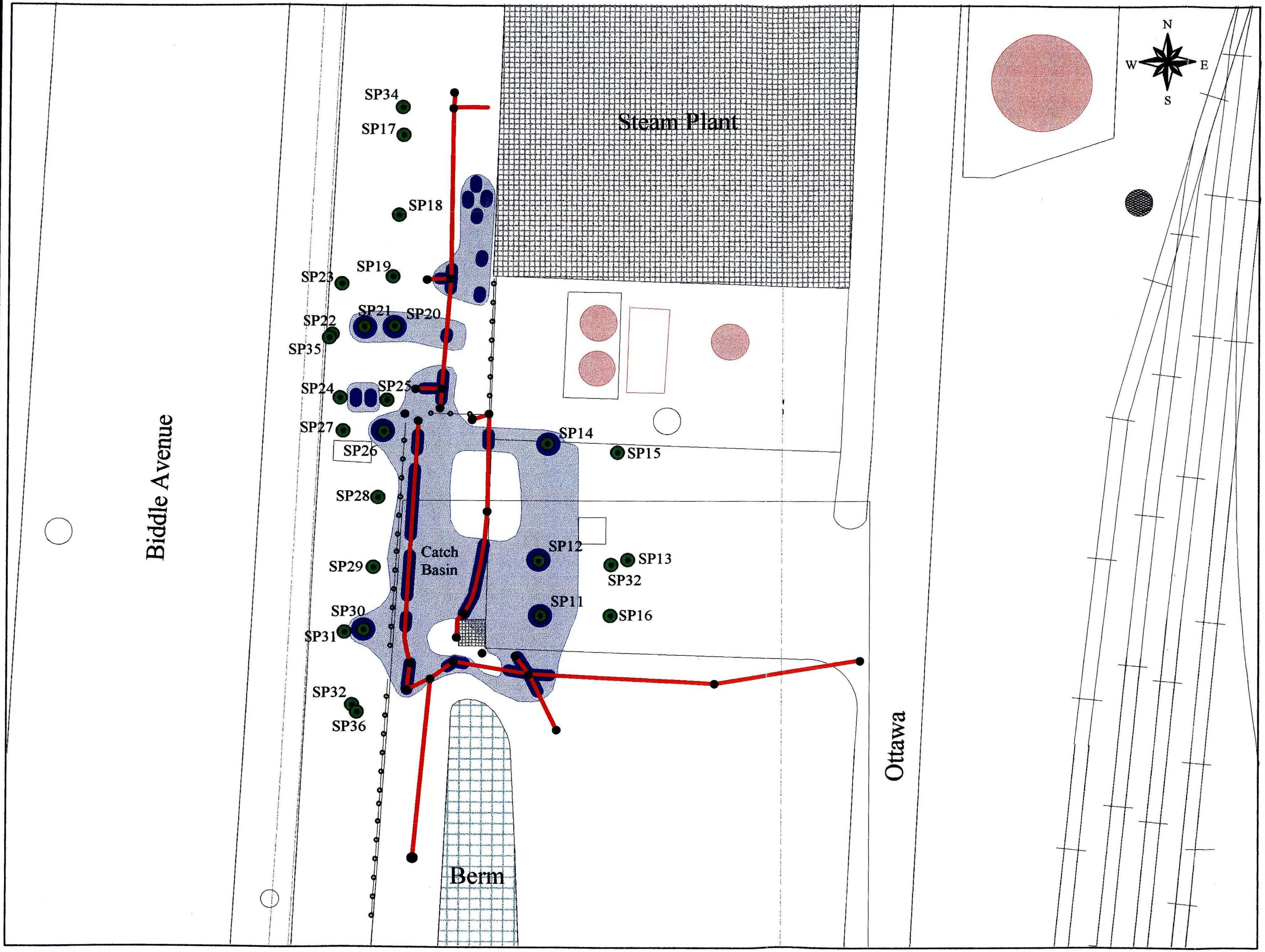
Revised: 02-26-99

Figure 7-26. Perimeter Delineation for AOC 7A

QST ENVIRONMENTAL

BASF

RCRA Facility Investigation
Wyandotte, Michigan



LEGEND

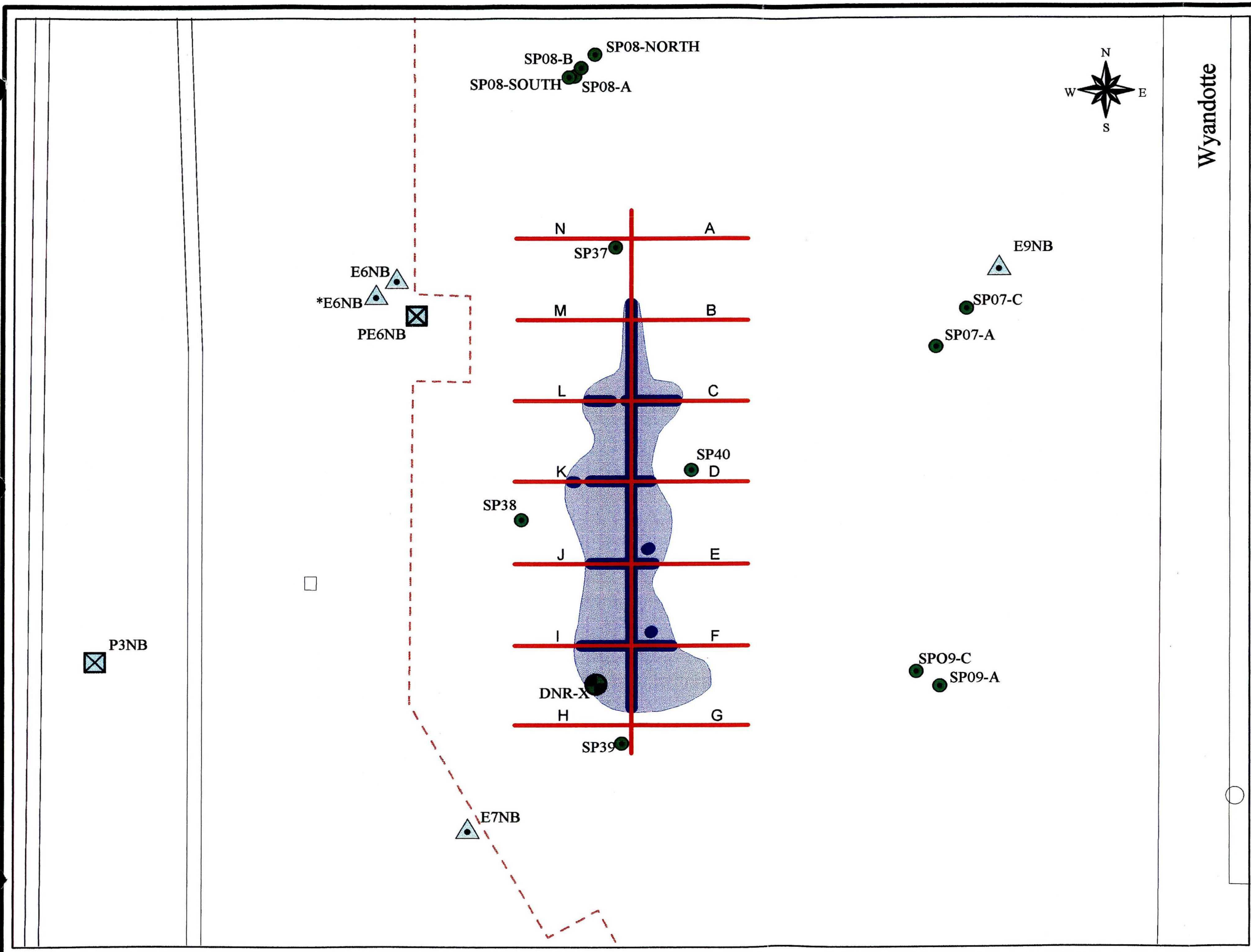
- AOC 7B Approximate Delineation
- Confirmed Boring or Surficial Locations of Prussian Blue
- Confirmed Trench Locations of Prussian Blue
- Perimeter Assessment Trenches
- Soil Boring Location
- Fenceline
- Storage Tank
- Manhole

10 0 10 20
Feet
1:400

Revised: 02-26-99

**Figure 7-27.
Perimeter Delineation
for AOC 7B**

QST ENVIRONMENTAL



BASF

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Wyandotte, Michigan

LEGEND

- AOC 7C Approximate Delineation
- Confirmed Surficial Locations of Prussian Blue
- Confirmed Trench Locations of Prussian Blue
- A - N Perimeter Assessment Trenches
- Soil Boring Location
- Existing Monitoring Well
- Piezometer Location
- Extraction Well
- Railroad Tracks
- Overhead Piping

Notes:

1) Surrounding soil borings were completed as part of the investigation for SWMU H.
2) Replacement wells/piezometers are labeled with an asterisk.

10 0 10 20
Feet
1:400

Revised: 02-26-99

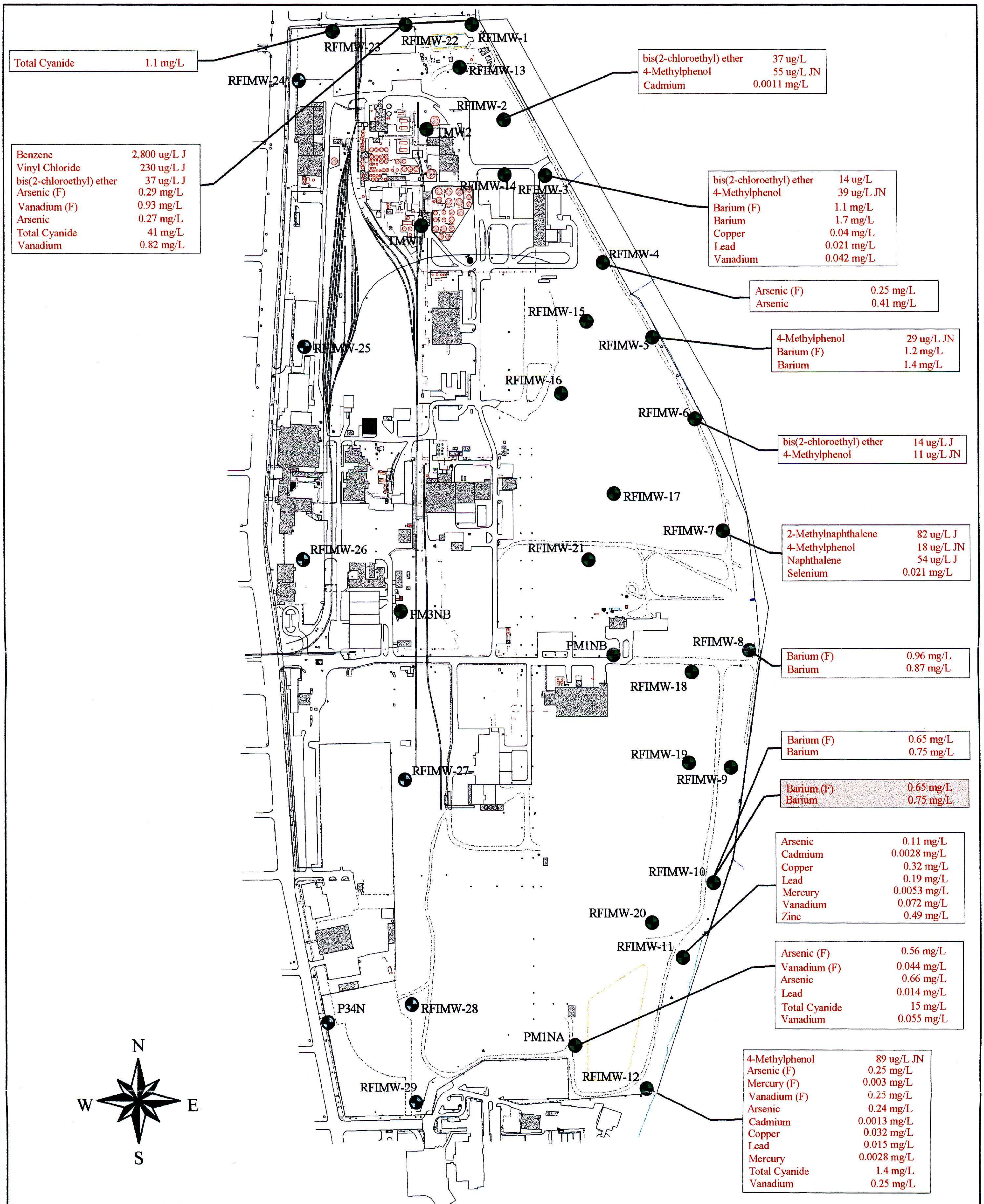
Figure 7-28.
Perimeter Delineation for AOC 7C

QST ENVIRONMENTAL

BASF

RCRA Facility Investigation

Wyandotte, Michigan



LEGEND

- Existing Monitoring Well
- Background Monitoring Well
- Storage Tank
- Building/Structure
- Unpaved Road
- Fenceline

Notes:

1) Analytical groundwater concentrations in red print denote sampling results which exceeded PSAL levels.
2) Analytical groundwater results represent total concentrations unless otherwise indicated. Results for filtered constituents are designated with a (F).
3) Results appearing in shaded boxes represent duplicate sample results.

500 0 500

Feet

1:6000

Revised: 02-26-99

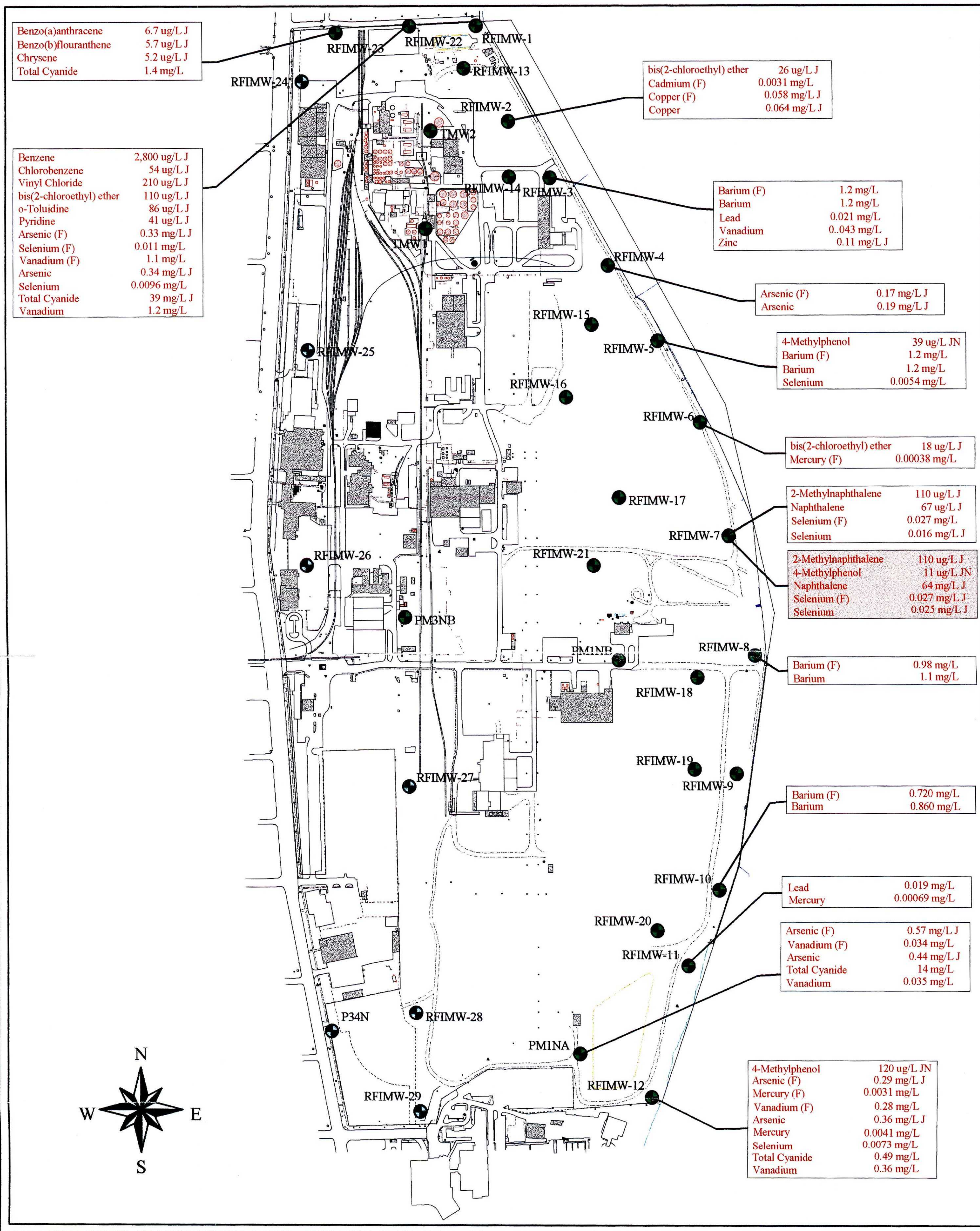
Figure 7-30. Selected Groundwater Concentrations (2nd Quarterly Event- December 1996)

QST ENVIRONMENTAL

BASF

RCRA Facility Investigation

Wyandotte, Michigan



LEGEND

- Existing Monitoring Well
- Background Monitoring Well
- Storage Tank
- Building/Structure
- Unpaved Road
- Fenceline

Notes:

1) Analytical groundwater concentrations in red print denote sampling results which exceeded PSAL levels.
2) Analytical groundwater results represent total concentrations unless otherwise indicated. Results for filtered constituents are designated with a (F).
3) Results appearing in shaded boxes represent duplicate sample results.

500 0 500

Feet

1:6000

Revised: 02-26-99

Figure 7-31. Selected Groundwater Concentrations (3rd Quarterly Event- March 1997)

QST ENVIRONMENTAL

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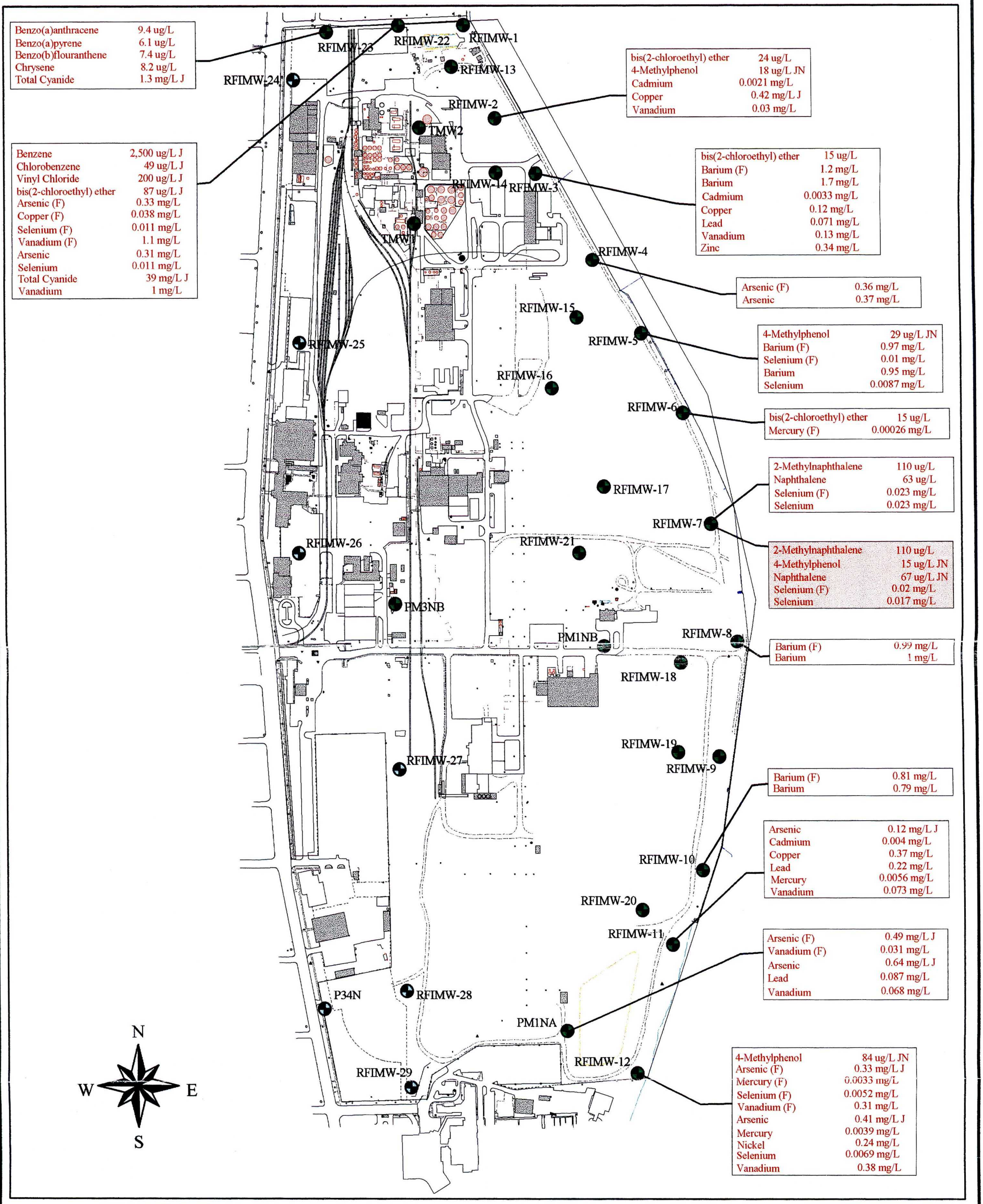
Wyandotte, Michigan



LEGEND

- Existing Monitoring Well
- Background Monitoring Well
- Storage Tank
- Building/Structure
- Unpaved Road
- Fenceline

Notes:

1) Analytical groundwater concentrations in red print denote sampling results which exceeded PSAL levels.
2) Analytical groundwater results represent total concentrations unless otherwise indicated. Results for filtered constituents are designated with a (F).
3) Results appearing in shaded boxes represent duplicate sample results.

500 0 500

Feet

1:6000

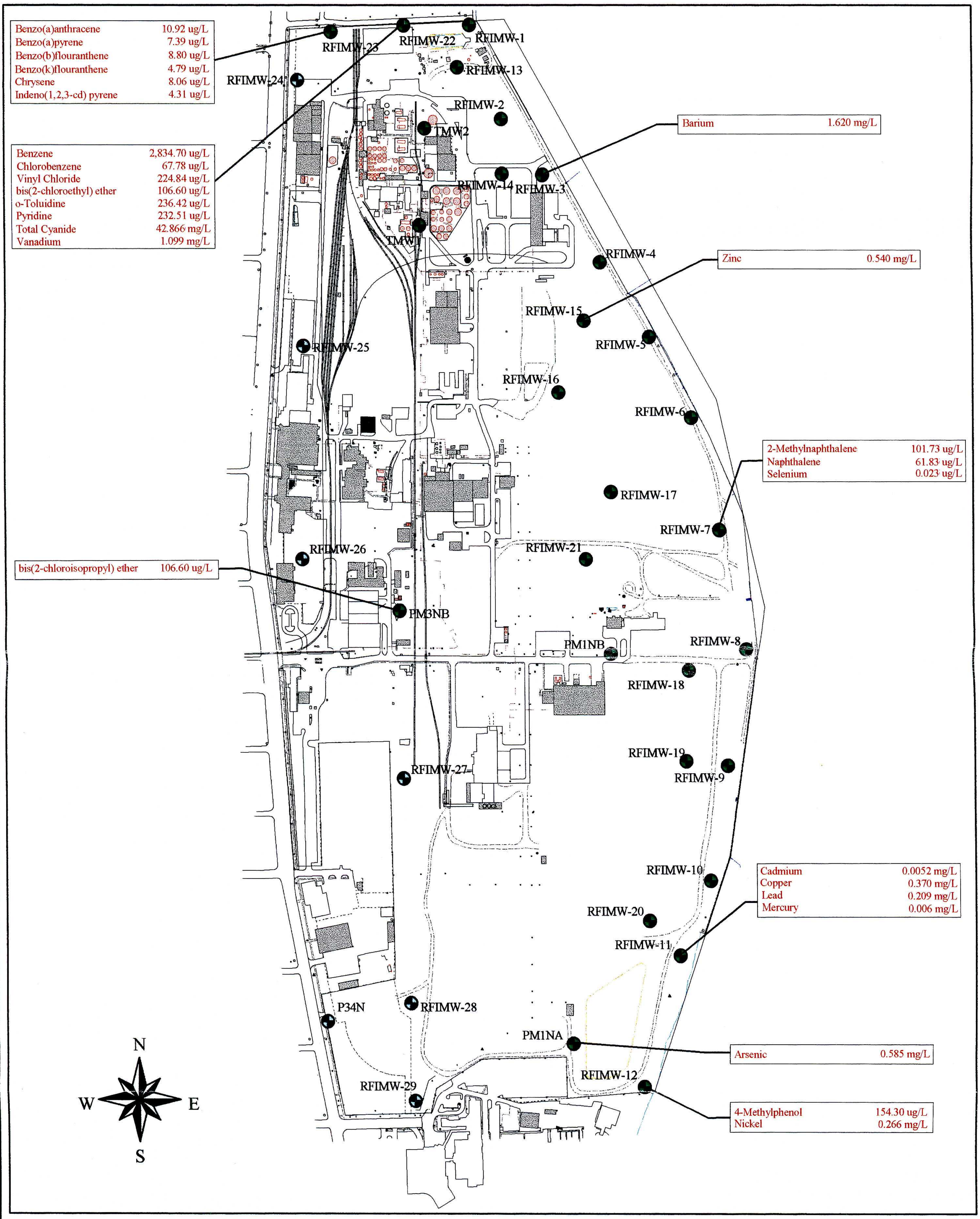
Revised: 02-26-99

Figure 7-32. Selected Groundwater Concentrations (4th Quarterly Event- June 1997)

QST ENVIRONMENTAL

BASF RCRA Facility Investigation

Wyandotte, Michigan



LEGEND

- Existing Monitoring Well
- Background Monitoring Well
- Storage Tank
- Building/Structure
- Unpaved Road
- Fenceline

Notes:

1) Highest value of the following:
   - highest 80% UCL value from the set of perimeter wells, or
   - highest analytical result for any individual non network monitoring well.

500 0 500

Feet

1:6000

Revised: 02-26-99

Figure 7-33. Maximum Statistical Groundwater Concentrations for Constituents which Exceed PSAL's

QST ENVIRONMENTAL

BASF

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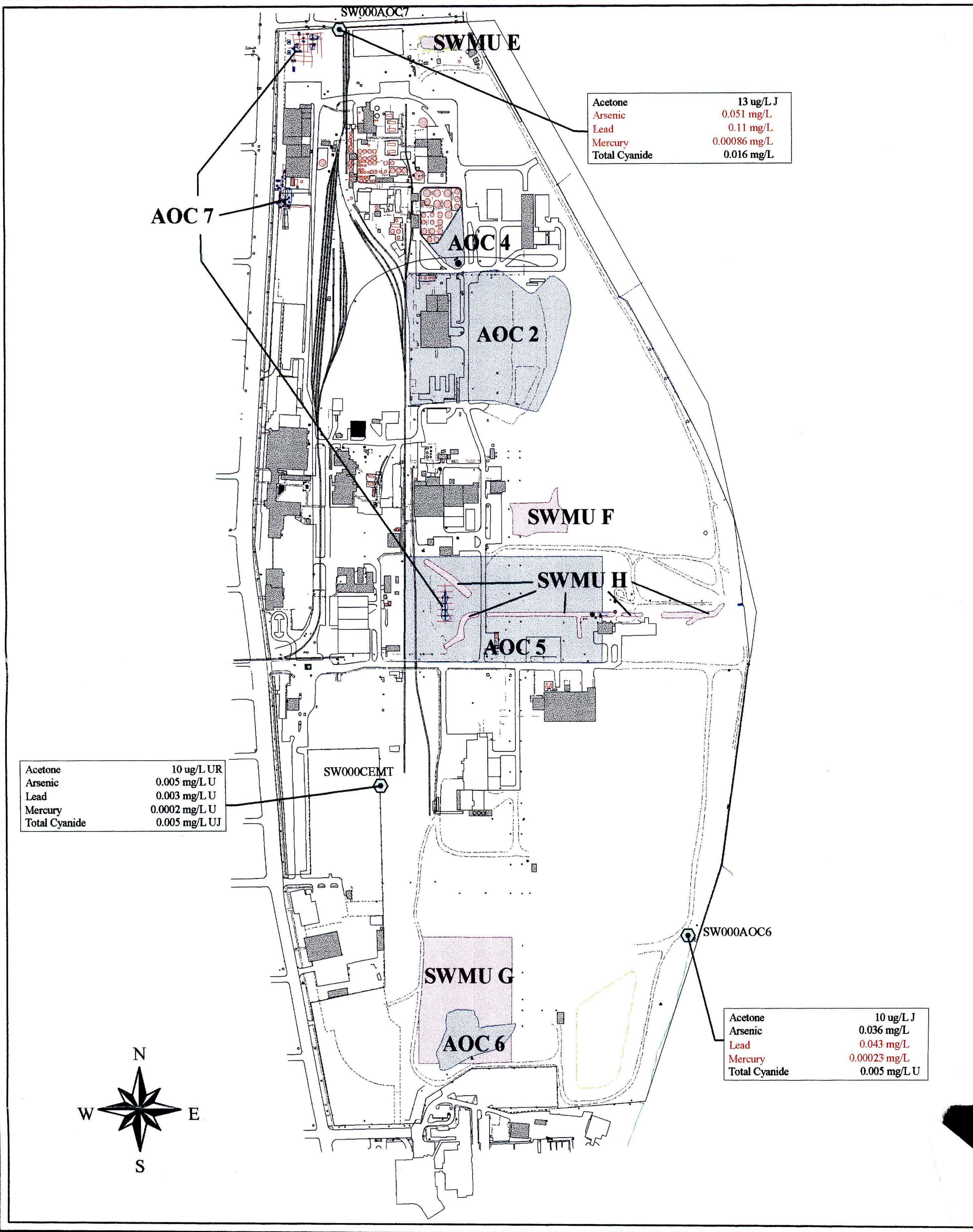
Wyandotte, Michigan



LEGEND

- Stormwater Runoff Sampling Location
- Solid Waste Management Unit (SWMU)
- Area of Concern (AOC)
- Storage Tank
- Building/Structure
- Perimeter Assessment Trench
- Unpaved Road

Notes:

1) Analytical concentrations in red print denote sampling results which exceeded PSAL levels.

500 0 500

Feet

1:6000

Revised: 02-26-99

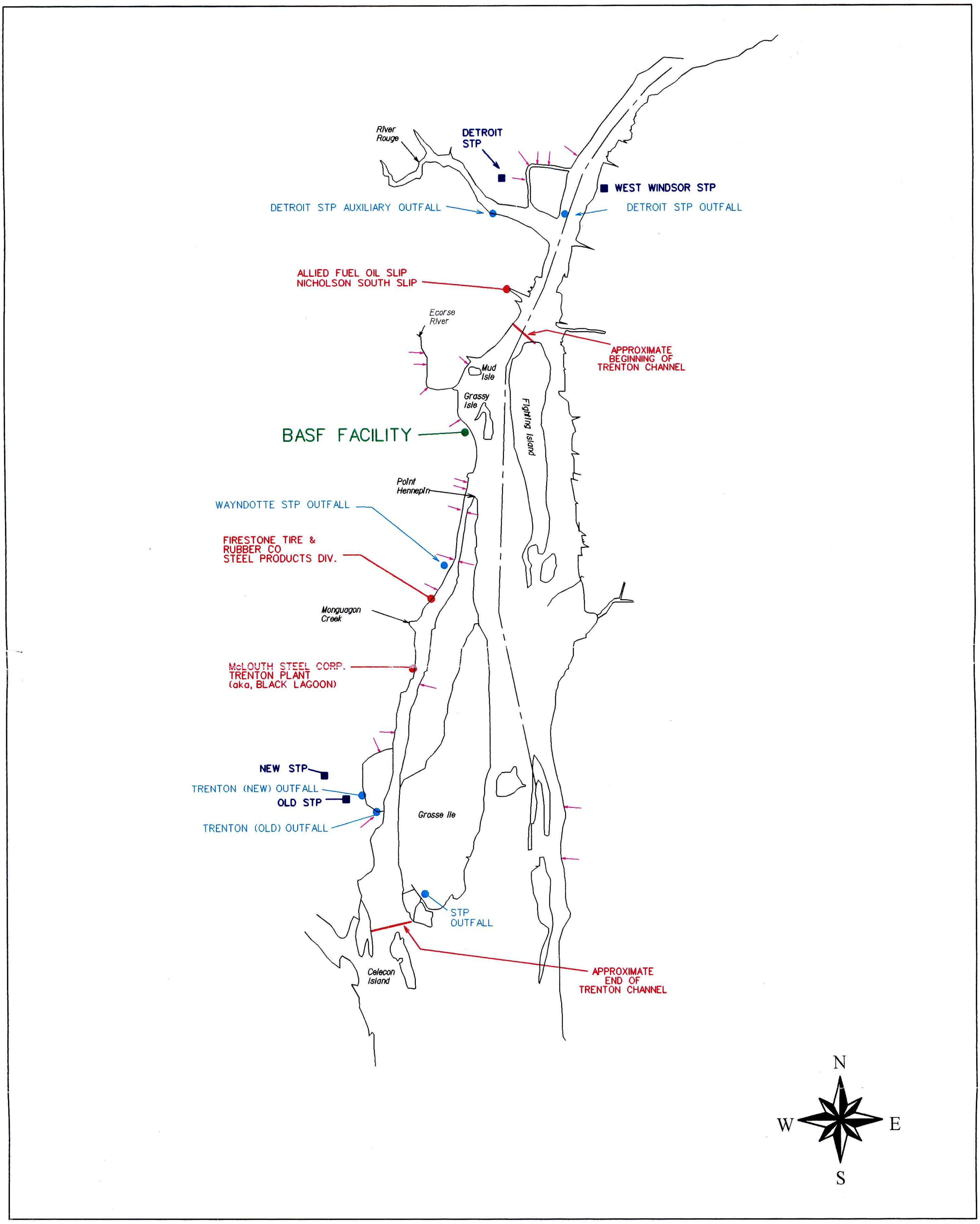
Figure 7-34. Selected Constituent Concentrations for Stormwater Runoff Samples

QST ENVIRONMENTAL

BASF

RCRA Facility Investigation

Wyandotte, Michigan



LEGEND

- STP SEWAGE TREATMENT PLANT OUTFALLS
- COMBINED SEWER OVERFLOWS
- SEWAGE TREATMENT PLANT LOCTIONS

5 0 5km

Figure 7-35
LOCATION OF BASF FACILITY RELATIVE TO REPORTED SIGNIFICANT TRENTON CHANNEL CONTAMINANT SOURCES

QST ENVIRONMENTAL

8.0 PRELIMINARY RISK ASSESSMENT

The overall objective of the preliminary risk assessment was to provide a determination of the potential magnitude of risk to human health and the environment associated with the actual or potential release of constituents from the Facility. This preliminary risk assessment provides an initial evaluation of the potential risk associated with each SWMU/AOC and helps to identify those areas that may require additional investigation. The risk assessment is considered to be preliminary at this time because additional investigative work may potentially be required at one or more SWMUs/AOCs. This preliminary evaluation was based on the data available as of November 1998, as described in previous sections of this report.

The preliminary risk assessment was composed of four separate components which were collectively integrated to meet the previously referenced objective. The components of the preliminary risk assessment included:

- Identification of Constituents of Concern (COCs);
- Exposure Assessment;
- Toxicity Assessment; and
- Risk Characterization.

8.1 Constituents of Concern

Constituents at the Facility have been identified from samples of soil and groundwater. Over 70 constituents have been detected in soil and groundwater samples collected at the Facility.
This significant number of constituents precluded a detailed risk analysis for each constituent detected or suspected of being present. At the same time, it is critical that the risk analysis evaluate 99 percent of the potential risks associated with the Facility (USEPA, 1989). As a result, it is necessary to identify a list of constituents that will be used to estimate exposures and to characterize the potential risk associated with the site. Therefore, constituents of concern (COCs) were identified to represent the most potentially hazardous constituents for receptors that may be exposed. Potential health risks evaluated for these COCs are expected to account for 99 percent of the total risk associated with the site.

The methodology for the selection of COCs utilized a risk-based screening procedure. As specified in Section 4.0, the risk-based screening process included a comparison of site data to preliminary site-specific action levels (PSALs). The COCs were identified by comparing the calculated UCL_{80} concentrations for the analytical soil and groundwater data collected from each SWMU and AOC to the PSALs. Those constituents whose UCL_{80} exceeded the PSAL were selected as COCs for the preliminary risk assessment.

The selected soil COCs for each SWMU and AOC are presented in Tables 8-1 through 8-10. The selected groundwater COCs for the Facility are presented in Table 8-11. For each COC, the detection frequency, minimum and maximum detected concentrations, as well as the mean and upper 95 percent confidence levels (UCL_{95}) are presented. Data used in calculating the means and UCL_{95} were included based on criteria in the Guidelines for Data Useability in Risk Assessment (USEPA, 1990). Data were first grouped according to media and source area. When a constituent concentration value was not positive or estimated, one-half of the reported detection limit was used in the statistical calculation of the mean, standard deviation, and UCL_{95}. The UCL_{95} was calculated assuming that all of the data was distributed lognormally.

8.2 Exposure Assessment

The exposure assessment uses the site description and constituent characterization presented in previous sections of the RFI Report to identify potentially exposed human and ecological populations, identify potential exposure pathways, and calculate estimated exposure levels of the constituents of concern. Behavioral and physiological factors influencing exposure frequency and levels are presented in a series of exposure scenarios as a basis for quantifying exposure levels for each identified exposure pathway. The results of the exposure analysis are applied in the assessment of human and ecological risks in subsequent sections.

This section includes a discussion of migration mechanisms and potential human health and ecological exposure pathways.

The approach taken in the actual calculation of exposure is to provide a discussion of each of the critical exposure routes that have been determined to be potentially significant at the Facility. Appendix F presents the exposure algorithms and key exposure assumptions used in this preliminary risk assessment. The exposure calculations are presented in Appendix G. This approach is intended to assist the reader in understanding the methodology and rationale used in the analysis without burdening the text with numerous calculation tables.

8.2.1 Migration Mechanisms

Constituents detected at the Facility may migrate off-site or may remain persistent at the site. Some COCs, such as the VOCs, are expected to be relatively mobile and may be transported from the soil to the shallow groundwater. Once in the groundwater, these mobile constituents may be transported downgradient. Other constituents, such as the SVOCs and inorganics are expected to be less mobile and may remain in the source area for much longer periods of time.

The COCs at the Facility may potentially migrate toward downgradient receptor locations and may be transported to other environmental media. COCs in the soil may remain persistent in the source areas or may be transported via the following major migration pathways:

- Soil to groundwater;
- Soil to surface water;
- Soil to sediment; and
- Soil to air.

In addition, once the COCs have migrated to other media, additional transport may potentially occur. For the Facility, this additional transport is expected to include the groundwater to air and groundwater to surface water pathways. Due to their low K_{oc} values, many of the VOCs are expected to be weakly adsorbed to the soils and sediments. As a result, mobility of these organics is expected. Due to the generally low solubility and high K_{oc} of the SVOCs, significant mobility is not expected. Generally, the metals are expected to be strongly adsorbed to the soils and sediments at the site and are not expected to be mobile.

Based on the available information, groundwater appears to be the major constituent migration pathway. Constituents may leach from soil and waste materials and enter groundwater and eventually migrate off-site.

Several constituents were detected at concentrations exceeding PSALs in stormwater runoff samples. Although no direct human or ecological exposure to these sample locations is expected, these data suggest that stormwater may provide a mechanism for the release of constituents from surface soils to surface water.

Other pathways such as volatilization from soil and groundwater and groundwater discharge to surface water are also expected to be significant. The physical and chemical properties of the constituents present at the Facility suggest that volatilization, oxidation, biodegradation, and soil adsorption are all important fate processes that may affect the migration of constituents.

8.2.2 Human Health Exposure Pathways

The analysis of exposure to human receptors is a complex process involving the use of numerous exposure assumptions. The assessment of pathways by which human receptors may be exposed to COCs at the Facility includes an examination of existing current exposure routes as well as those that may reasonably be expected to occur in the future. The determination of exposure routes is made by a careful examination of the current extent of affected media at the site and the results of the fate and transport assessment for predicting constituent migration pathways and estimating future exposure point concentrations.

The preliminary potential exposure routes that have been identified for the Facility.

Potential exposure routes for human receptors at the Facility include:

- Ingestion Pathway - This pathway includes ingestion of soil or surface water;
- Dermal Absorption Pathway - This pathway includes dermal absorption of constituents of concern from soil, groundwater, and surface water; and
- Inhalation Pathway - This pathway includes inhalation of dusts (emitted from surface soils) and vapors (volatilization from soil).

Based on information currently available, these exposure pathways are expected to account for the majority of exposure and risk associated with the Facility and are quantified in this preliminary risk assessment. Other exposure pathways are possible, however they are not expected to contribute significantly to the overall estimate of exposure and risk.

The exposure assessment estimates the total intake of COCs that the key receptor groups are expected to receive over various exposure periods. The key human receptor groups include:

- Current Workers;
- Future Workers; and
- Recreational Users.

Current worker activity is limited to either maintenance or Facility workers. Maintenance workers are responsible for routine landscaping (i.e., grass cutting) and other minor repair activities. Maintenance workers may be required to perform duties across the entire Facility. Facility workers are responsible for the operation of Facility processes and are more likely to be assigned to a single location at the Facility. Current exposures are expected only for those source areas with surface soil contamination, or where volatile COCs are present in subsurface soils.

Since future use of the Facility is not known at this time, the future worker exposure was separated into several possible scenarios based on possible future land use conditions. Future on-site receptors may include maintenance workers, Facility workers, or construction/utility workers. Construction/utility workers may be required to perform intensive soil excavation, trenching or other construction activity during a specified time period. This activity is typically performed by contract personnel. Future exposures are expected for each source area.

Recreational activity is limited to the Detroit River. Recreational receptors may include both adults and children who utilize the Detroit River for recreational activity. Examples of known recreational use include boating, rowing, jet skiing, and recreational fishing.

8.2.3 Ecological Exposure Pathways

The characterization of exposure is a key element of any ecological risk assessment. Although constituent stressors may be present, if receptors are not exposed to these constituents, no adverse effects would be anticipated. Exposure assessments evaluate the ways in which potential constituent intake occurs at the identified exposure point(s). It is important to consider the fact that the Facility is located in a heavily industrialized urban area and contains a relatively limited area for potential ecological exposure. The Facility has minimal habitat to support wildlife species of interest.

Generalized potential exposure pathways by which terrestrial and aquatic organisms may come into contact with COCs at the Facility include:

- Ingestion of or dermal contact with soils by soil invertebrates or wildlife;
- Ingestion of or dermal contact with surface water; and
- Ingestion of or dermal contact with sediments by benthic invertebrates or wildlife;

Terrestrial animals would likely be exposed on an intermittent basis. Aquatic species of animals and plants are generally inescapably immersed in the water medium. Water soluble constituents can enter an aquatic organism through the body surfaces (dermal and ocular), gills and mouth. Therefore, any COCs associated with the surface water may provide a direct exposure route for aquatic organisms.

Uptake by and bioaccumulation within the food web may represent an additional exposure pathway to aquatic and terrestrial organisms. Lower-trophic-level organisms, both aquatic and terrestrial, generally are exposed to COCs through direct contact with their environment and/or through ingestion of soil or plants. When these organisms are then consumed by predators, any constituents that have accumulated in their tissues are transferred into the predators.

For purposes of this preliminary risk evaluation, potential exposure of terrestrial organisms will be qualitatively assessed due to the lack of terrestrial habitat and limited exposure potential. Potential exposure of aquatic organisms is quantitatively assessed for potential ingestion and dermal contact. Bioaccumulation of COCs by aquatic and terrestrial organisms associated with the Facility will not be quantitatively assessed at this time.

8.3 Toxicity Assessment

8.3.1 Human Health Toxicity Criteria

In evaluating potential human health risks, both carcinogenic and noncarcinogenic health effects must be considered. Excessive exposure to any chemical constituent may potentially produce noncarcinogenic health effects, while the potential for carcinogenic effects is limited to exposure to certain substances. Therefore, it is necessary to identify and select noncarcinogenic health criteria for each COC to be evaluated in the risk assessment, and to identify and select carcinogenic health criteria only for those COCs that have evidence of carcinogenicity.

The criteria that are used in the evaluation of potential carcinogenic risks are carcinogenic slope factors (CSFs) that have been typically developed by the USEPA. The carcinogenic potency of a substance depends, in part, on its route of entry into the body (e.g., ingestion, inhalation, or dermal absorption). Therefore, slope factors are classified according to the route of administration, depending on the experimental or epidemiological data from which they were derived. Ideally, route-specific slope factors should be used to evaluate the potential carcinogenic risk posed by each carcinogen through each exposure route of concern. However, in reality, only a limited number of cancer slope factors have been derived, and many may exist for only one route of exposure.

Each potential COC detected at the Facility with evidence of carcinogenicity in animals and/or humans and classified by the USEPA as a carcinogen is considered to be carcinogenic in this risk assessment. The USEPA has developed oral and/or inhalation slope factors for some carcinogens (USEPA, 1997; USEPA, 1997). Dermal slope factors have not been derived for any constituents. In the absence of dermal slope factors, the slope factors for oral exposure were used to evaluate the dermal route. Although few data are available concerning the carcinogenic activity of substances that are systemically absorbed through exposure, the applied oral slope factors, when used in conjunction with a conservative absorption factor are expected to provide a conservative estimate of potential risk of systemic cancer through dermal exposure. In accordance with USEPA (1989), the oral slope factor was divided by the carcinogenic constituent's ingestion absorption efficiency to estimate the dermal slope factor.

The criteria used to evaluate the potential for noncarcinogenic health effects are generally referred to as Reference Doses (RfDs). RfDs, like CSFs, are developed for specific exposure routes. RfDs have been derived by the USEPA for a number of constituents for the oral and/or inhalation routes of exposure, but have not been developed for the dermal route. When available, route-specific RfDs were used for each constituent. Oral RfDs were used to evaluate toxicity associated with the dermal exposure pathways. In accordance with USEPA (1989), the oral RfD was multiplied by the noncarcinogenic constituent's ingestion absorption efficiency to estimate the dermal RfD.

The available USEPA oral and inhalation health effects criteria for the COCs at the Facility are presented in Tables 8-12 and 8-13. The oral RfDs and oral CSFs for the COCs are shown on Table 8-12 with the carcinogenic classification for each carcinogenic COC. The inhalation RfDs, and inhalation CSFs for the COCs are shown on Table 8-13. The derived dermal health effects criteria for the COCs are presented in Table 8-14.

8.3.2 Ecological Toxicity Criteria

The environmental toxicity of the COCs is assessed using available water quality criteria. The primary source of surface water quality criteria for the Detroit River are the Michigan Rule 57(2) Guideline Levels. However, Michigan Rule 57(2) Guideline Levels are not available for each COC that may potentially impact the Detroit River. Consequently, other guidance such as USEPA Water Quality Standards, and USEPA Ecotox Thresholds (ETs) were used as appropriate. The Michigan Rule 57(2) Guideline Levels for protection of aquatic life as well as the USEPA Water Quality Standards and ETs are intended to protect 95 percent of the aquatic organisms, including fish, invertebrates, and aquatic plants. Therefore, not only fish, but also other aquatic organisms are also protected. Consequently, a comparison of the maximum predicted surface water concentrations with these criteria will be used to determine the likelihood of adverse effects to aquatic life. The available water quality criteria for the COCs discharging to the Detroit River are presented in Table 8-15.

8.4 Preliminary Risk Characterization

The objectives of characterizing potential risk are to integrate information developed in the exposure assessment and the toxicity assessment into a complete evaluation of the potential human health and environmental risks associated with COCs detected in samples collected at the Facility. This preliminary risk assessment evaluates the nature and degree of risk to potential human health and environmental receptors described in Section 8.2. Potential risk estimates are derived for individual COCs and for the total COC contribution from each source area of concern to identify the media and COCs posing the most significant concerns. The results of the preliminary risk characterization may be used to develop recommendations for future investigations. The methods used in the risk analysis are those presented in the USEPA Risk Assessment Guidance for Superfund: Human Health Evaluation Manual (1989).

Potential human health and environmental risks were determined for each of the exposure pathways described in Section 8.2. The potential human health risks were evaluated separately for noncarcinogenic and carcinogenic effects. Carcinogenic compounds were also evaluated for their noncarcinogenic effects. The potential human health risks for the Facility were evaluated based on the exposure assumptions presented in Appendix F. The potential environmental risks were evaluated on the basis of predicted surface water concentrations in the Detroit River as presented in Appendix G.

Following the description of the potential risks associated with exposures to COCs at each source area, the uncertainties associated with the preliminary risk analysis are presented. These uncertainties may be attributable to lack of monitoring data, incomplete understanding of the mechanisms involved in constituent transport, assumptions used in the exposure assessment, or a lack of toxicological information for a particular constituent.

Potential human health risks are presented independently for carcinogenic and noncarcinogenic constituents because of the different toxicological endpoints, relevant exposure durations, and methods employed in characterizing potential risk.

8.4.1 Preliminary Human Health Risks

Incidental potential human health risks associated with exposure to carcinogenic constituents of concern were calculated based on USEPA (1986) Guidelines for Carcinogenic Risk Assessment, and USEPA (1986) Guidelines for the Health Risk Assessment of Chemical Mixtures. Potential cancer risks were first calculated for individual constituents by multiplying exposure levels of each

$$Risk = I \times CSF$$

constituent by the appropriate CSF (CSFs are discussed in Section 8.3) as follows:

where: Risk = Probability of an individual developing cancer,

I = Chronic daily chemical intake averaged over a lifetime of 70 years (mg/kg-day), and

CSF = Slope factor, expressed in $(\text{mg/kg-day})^{-1}$ (CSFs are presented in Tables 8-12, 8-13, and 8-14)

Although estimating potential risk by considering one chemical at a time might significantly under estimate the potential risks associated with simultaneous exposures to several substances, the total combined potential health risks were also evaluated for each pathway by summing estimates derived for each compound for that pathway as follows:

$$Risk_T = \Sigma Risk_i$$

where: $Risk_T$ = The total cancer risk, expressed as a unitless probability, and

$Risk_i$ = The risk estimate for the i^{th} substance.

The additive approach is in accordance with USEPA guidelines on chemical mixtures in which potential risks associated with carcinogens are considered additive. Thus, risks from inhalation, dermal absorption, and oral exposures can be added to estimate the total overall potential risk to human receptors as follows:

Total Exposure Cancer Risk = Risk (exposure pathway 1) + Risk (exposure pathway 2) + Risk (exposure pathway I)

The site-specific potential carcinogenic risk estimates were based on the exposure factors presented in Appendix F. To provide a perspective on the potential risks associated with the Facility, the magnitude of the potential cancer risks associated with the known or suspected carcinogens detected at the site were compared to the USEPA acceptable cancer risk range of 1.0E-04 to 1.0E-06. Acceptable exposure levels are the residual concentration levels that represent an excess cancer risk to an individual of between 1.0E-04 to 1.0E-06 [55 Federal Register (FR) 46:8848, March 8, 1990] based on the dose and response information for the particular constituent. The National Contingency Plan (NCP) has identified an excess upper-bound lifetime cancer risk of 1.0E-06 as the point of departure for determining the need for remediation of constituents that do not have applicable or relevant and appropriate requirements (ARARs) or for which an ARAR is not sufficiently protective because of the presence of multiple constituents or multiple pathways of exposure (55 FR 46:8848, March 8, 1990).

The measure used to describe the potential for noncarcinogenic toxicity to occur in an individual is not expressed as a probability. The potential for noncarcinogenic effects is evaluated by comparing an exposure level over a specified time period (e.g., the daily dose in mg/kg/day for a long period up to a lifetime) with an RfD derived for a similar period (USEPA, 1989). This ratio of exposure to toxicity is called a noncarcinogenic hazard index (HI) and is calculated as follows:

$$Noncancer\ Hazard\ Index\ (HI) = \frac{E}{RfD}$$

where: E = Exposure level (or chemical intake averaged over the duration of exposure),
RfD = Reference dose (RfDs are discussed in Section 8.3)

The HI assumes that there is a level of exposure (i.e., RfD) below which it is unlikely for even sensitive populations to experience adverse health effects (USEPA, 1989). If the exposure level exceeds the threshold level (i.e., if E/RfD exceeds unity or HI > 1.0), there may be a concern for potential noncarcinogenic effects. As with the carcinogenic constituent evaluation, estimating noncancer hazard potential by considering one constituent at a time might significantly under estimate the potential risks associated with simultaneous exposures for each pathway. By summing estimates derived for each constituent, the total pathway HI is calculated as follows:

$$HI = \frac{E_1}{RfD_1} + \frac{E_2}{RfD_2} + \ldots + \frac{E_i}{RfD_i}$$

where: E_i = Exposure level (dose) for the i^{th} constituent,
RfD_i = Reference dose for the i^{th} constituent.

This additive approach assumes that multiple subthreshold exposures could result in an adverse effect and that the magnitude of the effect is proportional to the sum of the ratios of the exposure to acceptable exposures. The assumption of additivity is applicable to constituents that induce the same type of effect. If the total HI is greater than unity, constituents are reevaluated by critical effect, and separate HIs are calculated by type of effect. The possible effects of multimedia exposures are evaluated by summing the HI values for the relevant exposure routes.

As an HI approaches 10 to 3,000, the uncertainty in the RfD is greatly reduced because of the safety margin incorporated in the RfD (on the order of 10 to 3,000 to account for animal-to-human dose extrapolations and species-to-species differences) has been reduced or eliminated. Therefore, an HI ranging from 10 to 3,000 not only indicates that chronic effects are posed to potential human receptors, but acute and subchronic effects may also be posed.

The potential on-site and off-site human health risk estimates associated with the Facility are presented in detail in Appendix G. Following is a discussion of the preliminary potential health risks associated with each area investigated. The potential risks are specific to the previously presented exposure scenarios.

<u>SWMU F</u>

The potential risks associated with SWMU F are presented in Table 8-16.

Current maintenance workers may be potentially exposed to volatile COCs in subsurface soil through the vapor inhalation pathway. The total adult worker HIs for the current maintenance worker range from 5E-03 to 3E-02. Since the total HIs are less than unity, there is no concern for potential noncarcinogenic health effects for the current maintenance worker at SWMU F. The total potential carcinogenic risk levels for the current maintenance worker range from 1E-07 to 9E-07. Since these cancer risk estimates are below the target range (1E-04 to 1E-06), there is no potential unacceptable carcinogenic health risk associated with the current maintenance worker.

Future maintenance workers may be potentially exposed to COCs through soil ingestion, soil dermal absorption, as well as dust and vapor inhalation. The total adult worker HIs for the future maintenance worker range from 2E-02 to 1E-01. Since the total HIs are less than unity, there is no concern for potential noncarcinogenic health effects for the future maintenance worker at SWMU F. The total potential carcinogenic risk levels for the future maintenance worker range from 7E-07 to 3E-06. Since these risk estimates are below or within the target range (1E-04 to 1E-06), there is no potential unacceptable carcinogenic health risk associated with the future maintenance worker.

Future Facility workers may be potentially exposed to COCs through soil ingestion, soil dermal absorption, as well as dust and vapor inhalation. The total adult worker HIs for the future Facility worker range from 8E-02 to 4E-01. Since the total HIs are less than unity, there is no concern for potential noncarcinogenic health effects for the future Facility worker at SWMU F. The total potential carcinogenic risk levels for the future Facility worker range from 3E-06 to 1E-05. Since these risk estimates are within the target range (1E-04 to 1E-06), there is no potential unacceptable carcinogenic health risk associated with the future Facility worker.

Future construction/utility workers may be potentially exposed to COCs through soil ingestion, soil dermal absorption, as well as dust and vapor inhalation. Construction/utility workers may also be exposed to COCs through dermal absorption of groundwater. The total adult worker HIs for the future construction/utility worker range from 1E-01 to 5E-01. Since the total HIs are less than unity, there is no concern for potential noncarcinogenic health effects for the future construction/utility worker at SWMU F. The total potential carcinogenic risk levels for the future construction/utility worker range from 2E-05 to 2E-05. Since these risk estimates are within the target range (1E-04 to 1E-06), there is no potential unacceptable carcinogenic health risk associated with the future construction/utility worker at SWMU F.

<u>SWMU G</u>

The potential risks associated with SWMU G are presented in Table 8-17.

Current maintenance workers may be potentially exposed through soil ingestion, soil dermal absorption and dust inhalation pathways. The total adult worker HIs for the current maintenance worker range from 1E-04 to 3E-04. Since the total HIs are less than unity, there is no concern for potential noncarcinogenic health effects for the current maintenance worker at SWMU G. The total potential carcinogenic risk levels for the current maintenance worker range from 3E-08 to 7E-08. Since these cancer risk estimates are below the target range (1E-04 to 1E-06), there is no potential unacceptable carcinogenic health risk associated with the current maintenance worker.

Future maintenance workers may be potentially exposed to COCs through soil ingestion, soil dermal absorption, and dust inhalation. The total adult worker HIs for the future maintenance worker range from 5E-04 to 1E-03. Since the total HIs are less than unity, there is no concern for potential noncarcinogenic health effects for the future maintenance worker at SWMU G. The total potential carcinogenic risk levels for the future maintenance worker range from 1E-07 to 2E-07. Since these risk estimates are below the target range (1E-04 to 1E-06), there is no potential unacceptable carcinogenic health risk associated with the future maintenance worker.

Future Facility workers may be potentially exposed to COCs through soil ingestion, soil dermal absorption, and dust inhalation. The total adult worker HIs for the future Facility worker range from 5E-03 to 1E-02. Since the total HIs are less than unity, there is no concern for potential noncarcinogenic health effects for the future Facility worker at SWMU G. The total potential carcinogenic risk levels for the future Facility worker range from 1E-06 to 2E-06. Since these risk estimates are within the target range (1E-04 to 1E-06), there is no potential unacceptable carcinogenic health risk associated with the future Facility worker.

Future construction/utility workers may be potentially exposed to COCs through soil ingestion, soil dermal absorption, and dust inhalation. Construction/utility workers may also be exposed to COCs through dermal absorption of groundwater. The total adult worker HIs for the future construction/utility worker range from 2E-02 to 5E-02. Since the total HIs are less than unity, there is no concern for potential noncarcinogenic health effects for the future construction/utility worker at SWMU G. The total potential carcinogenic risk levels for the future construction/utility worker range from 2E-05 to 2E-05. Since these risk estimates are within the target range (1E-04 to 1E-06), there is no potential unacceptable carcinogenic health risk associated with the future construction/utility worker.

<u>SWMU H</u>

The potential risks associated with SWMU H are presented in Table 8-18.

Current maintenance workers may be potentially exposed to volatile COCs in subsurface soil through the vapor inhalation pathway. The total adult worker HIs for the current maintenance worker range from 2E+00 to 2E+01. Since the total HIs exceed unity, there is a concern for potential noncarcinogenic health effects for the current maintenance worker at SWMU H. The estimated inhalation of 1,2-dichloropropane accounts for approximately 99 percent of the total HI. The total potential carcinogenic risk levels for the current maintenance worker range from 7E-05 to 6E-04. Since these cancer risk estimates exceed the target range (1E-04 to 1E-06), there is a potential unacceptable carcinogenic health risk associated with the current maintenance worker. The inhalation of 1,2-dichloropropane accounts for approximately 99 percent of the total potential carcinogenic risk estimate.

Future maintenance workers may be potentially exposed to COCs through soil ingestion, soil dermal absorption, as well as dust and vapor inhalation. The total adult worker HIs for the future maintenance worker range from 9E+00 to 9E+01. Since the total HIs exceed unity, there is a concern for potential noncarcinogenic health effects for the future maintenance worker at SWMU H. The estimated inhalation of 1,2-dichloropropane accounts for approximately 99 percent of the total HI. The total potential carcinogenic risk levels for the future maintenance worker range from 3E-04 to 2E-03. Since these risk estimates exceed the target range (1E-04 to 1E-06), there is a potential unacceptable carcinogenic health risk associated with the future maintenance worker. The inhalation of 1,2-dichloropropane accounts for approximately 99 percent of the total potential carcinogenic risk estimate.

Future Facility workers may be potentially exposed to COCs through soil ingestion, soil dermal absorption, as well as dust and vapor inhalation. The total adult worker HIs for the future Facility worker range from 3E+01 to 3E+02. Since the total HIs exceed unity, there is a concern for potential noncarcinogenic health effects for the future Facility worker at SWMU H. The estimated inhalation of 1,2-dichloropropane accounts for approximately 99 percent of the total HI. The total potential carcinogenic risk levels for the future Facility worker range from 9E-04 to 8E-03. Since these risk estimates exceed the target range (1E-04 to 1E-06), there is a potential unacceptable carcinogenic health risk associated with the future Facility worker. The inhalation of 1,2-dichloropropane accounts for approximately 99 percent of the total potential carcinogenic risk estimate.

Future construction/utility workers may be potentially exposed to COCs through soil ingestion, soil dermal absorption, as well as dust and vapor inhalation. Construction/utility workers may also be exposed to COCs through dermal absorption of groundwater. The total adult worker HIs for the future construction/utility worker range from 3E+01 to 3E+02. Since the total HIs exceed unity, there is a concern for potential noncarcinogenic health effects for the future construction/utility worker at SWMU H. The vapor inhalation pathway accounts for approximately 98 percent of this total HI estimate, and the soil ingestion pathway accounts for approximately 2 percent of this total HI. Estimated inhalation of 1,2-dichloropropane vapors from soil and ingestion of 1,2-dichloropropane from soil accounts for approximately 99 percent of the total HI. The total potential carcinogenic risk levels for the future construction/utility worker range from 1E-04 to 9E-04. Since these risk estimates exceed the target range (1E-04 to 1E-06), there is a potential for unacceptable carcinogenic health risks associated with the future construction/utility worker. The vapor inhalation pathway accounts for approximately 96 percent of the total potential carcinogenic risk estimate. The inhalation of 1,2-dichloropropane accounts for approximately 99 percent of the total potential carcinogenic risk estimate.

AOC 1

The potential risks associated with AOC 1 are presented in Table 8-19.

Current Facility workers may be potentially exposed to volatile COCs from the subsurface through the vapor inhalation pathway. The total adult worker HIs (RAE and RME) for the current Facility worker are both 2E-02. Since the total HIs are less than unity, there is no concern for potential noncarcinogenic health effects for the current Facility worker at AOC 1. The total potential carcinogenic risk level for the current Facility worker is 3E-07. Since this cancer risk estimate is below the target range (1E-04 to 1E-06), there is no potential unacceptable carcinogenic health risk associated with the current Facility worker at AOC 1.

Future maintenance workers may be potentially exposed to COCs through soil ingestion, soil dermal absorption, dust inhalation and vapor inhalation. The total adult worker HIs for the future maintenance worker are both 2E-02. Since the total HIs are less than unity, there is no concern for potential noncarcinogenic health effects for the future maintenance worker at AOC 1. The total potential carcinogenic risk level for the future maintenance worker is 3E-07. Since this risk estimates is below the target range (1E-04 to 1E-06), there is no potential unacceptable carcinogenic health risk associated with the future maintenance worker.

Future Facility workers may be potentially exposed to COCs through soil ingestion, soil dermal absorption, dust inhalation and vapor inhalation. The total adult worker HIs for the future Facility worker range from 7E-02 to 8E-02. Since the total HIs are less than unity, there is no concern for potential noncarcinogenic health effects for the future maintenance worker at AOC 1. The total potential carcinogenic risk level for the future Facility worker is 1E-06. Since this risk estimate is within the target range (1E-04 to 1E-06), there is no potential unacceptable carcinogenic health risk associated with the future Facility worker.

Future construction/utility workers may be potentially exposed to COCs through soil ingestion, soil dermal absorption, dust inhalation and vapor inhalation. Construction/utility workers may also be exposed to COCs through dermal absorption of groundwater. The total adult worker HIs for the future construction/utility worker range from 5E-01 to 6E-01. Since the total HIs are less than unity, there is no concern for potential noncarcinogenic health effects for the future construction/utility worker at AOC 1. The total potential carcinogenic risk level for the future construction/utility worker is 2E-05. Since this risk estimate is within the target range (1E-04 to 1E-06), there is no potential for unacceptable carcinogenic health risks associated with the future construction/utility worker.

AOC 2

The potential risks associated with AOC 2 are presented in Table 8-20.

Exposure to current maintenance workers was not evaluated because there is no surface contamination and because there are no volatile organic COCs at AOC 2.

Future maintenance workers may be potentially exposed to COCs through soil ingestion, soil dermal absorption, and dust inhalation. The total adult worker HIs for the future maintenance worker range from 4E-04 to 1E-03. Since the total HIs are less than unity, there is no concern for potential noncarcinogenic health effects for the future maintenance worker at AOC 2. The total potential carcinogenic risk levels for the future maintenance worker range from 1E-07 to 3E-07. Since these risk estimates are below the target range (1E-04 to 1E-06), there is no potential unacceptable carcinogenic health risk associated with the future maintenance worker.

Future Facility workers may be potentially exposed to COCs through soil ingestion, soil dermal absorption, and dust inhalation. The total adult worker HIs for the future Facility worker range from 4E-03 to 1E-02. Since the total HIs are less than unity, there is no concern for potential noncarcinogenic health effects for the future Facility worker at AOC 2. The total potential carcinogenic risk levels for the future Facility worker range from 7E-07 to 2E-06. Since these risk estimates are below or within the target range (1E-04 to 1E-06), there is no potential unacceptable carcinogenic health risk associated with the future Facility worker.

Future construction/utility workers may be potentially exposed to COCs through soil ingestion, soil dermal absorption, and dust inhalation. Construction/utility workers may also be exposed to COCs through dermal absorption of groundwater. The total adult worker HIs for the future construction/utility worker range from 2E-02 to 4E-02. Since the total HIs are less than unity, there is no concern for potential noncarcinogenic health effects for the future construction/utility worker at AOC 2. The total potential carcinogenic risk levels for the future construction/utility worker range from 2E-05 to 2E-05. Since these risk estimates are within the target range (1E-04 to 1E-06), there is no potential unacceptable carcinogenic health risk associated with the future construction/utility worker.

AOC 4

The potential risks associated with AOC 4 are presented in Table 8-21.

Current Facility workers may be potentially exposed to volatile COCs from the subsurface through the vapor inhalation pathway. The total adult worker HIs for the current Facility worker range from 2E-01 to 4E-01. Since the total HIs are less than unity, there is no concern for potential noncarcinogenic health effects for the current Facility worker at AOC 4. The total potential carcinogenic risk levels for the current Facility worker range from 4E-06 to 6E-06. Since these cancer risk estimates are within the target range (1E-04 to 1E-06), there is no potential unacceptable carcinogenic health risk associated with the current Facility worker.

Future maintenance workers may be potentially exposed to COCs through soil ingestion, soil dermal absorption, and vapor inhalation. The total adult worker HIs for the future maintenance worker range from 3E-01 to 5E-01. Since the total HIs are less than unity, there is no concern for potential noncarcinogenic health effects for the future maintenance worker at AOC 4. The total potential carcinogenic risk levels for the future maintenance worker range from 1E-04 to 1E-04. Since these risk estimates are within the target range (1E-04 to 1E-06), there is no potential unacceptable carcinogenic health risk associated with the future maintenance worker. Although 1E-04 is at the limit of the acceptable risk range, the uncertainty associated with the determination of this risk value indicates that the actual risk is less than 1E-04. Please refer to Section 8.4.3 for further discussion of uncertainty issues.

Future Facility workers may be potentially exposed to COCs through soil ingestion, soil dermal absorption, and vapor inhalation. The total adult worker HIs for the future Facility worker range from 1E+00 to 2E+00. Since the total HIs exceed unity, there is a concern for potential noncarcinogenic health effects for the future Facility worker at AOC 4. The estimated vapor inhalation of benzene accounts for approximately 60 percent of the total HI. The total potential carcinogenic risk levels (RAE and RME) for the future Facility worker are both 1E-03. Since these risk estimates exceed the target range (1E-04 to 1E-06), there is a potential unacceptable carcinogenic health risk associated with the future Facility worker. The soil ingestion and dermal absorption pathways accounts for approximately 76 and 22 percent, respectively, of the total potential carcinogenic risk estimate. The measured concentrations of the carcinogenic PAHs account for approximately 99 percent of the total potential carcinogenic risk estimate.

Future construction/utility workers may be potentially exposed to COCs through soil ingestion, soil dermal absorption, and vapor inhalation. Construction/utility workers may also be exposed to COCs through dermal absorption of groundwater. The total adult worker HIs for the future construction/utility worker range from 8E+00 to 1E+01. Since the total HIs exceed unity, there is a concern for potential noncarcinogenic health effects for the future construction/utility worker at AOC 4. The soil ingestion and vapor inhalation pathways combine to account for 97 percent of the total HI. Soil ingestion of dibenzofuran and naphthalene, vapor inhalation of benzene accounts for approximately 99 percent of the total HI. (The estimated vapor inhalation of benzene alone accounts for nearly 90 percent of the total HI.) The total potential carcinogenic risk levels for the future construction/utility worker range from 1E-04 to 2E-04. Since these risk estimates exceed the target range (1E-04 to 1E-06), there is a potential for unacceptable carcinogenic health risks associated with the future construction/utility worker. The soil ingestion and groundwater dermal absorption pathway account for approximately 95 percent of the total potential carcinogenic risk estimate. The soil ingestion and groundwater dermal absorption of the carcinogenic PAHs account for approximately 99 percent of the total potential carcinogenic risk estimate. (The estimated soil ingestion of carcinogenic PAHs alone accounts for nearly 90 percent of the total carcinogenic risk estimate.)

<u>AOC 5</u>

The potential risks associated with AOC 5 are presented in Table 8-22.

Exposure to current maintenance workers was not evaluated because there is no surface contamination and because there are no volatile organic COCs at AOC 5.

Future maintenance workers may be potentially exposed to COCs through soil ingestion, soil dermal absorption, and dust inhalation. The total adult worker HIs for the future maintenance worker range from 1E-06 to 2E-06. Since the total HIs are less than unity, there is no concern for potential noncarcinogenic health effects for the future maintenance worker at AOC 5. Potential carcinogenic risks for future maintenance workers were not estimated for AOC 5 because there are no carcinogenic COCs in soil.

Future Facility workers may be potentially exposed to COCs through soil ingestion, soil dermal absorption, and dust inhalation. The total adult worker HIs for the future Facility worker range from 1E-05 to 2E-05. Since the total HIs are less than unity, there is no concern for potential noncarcinogenic health effects for the future Facility worker at AOC 5. Potential carcinogenic risks for future Facility workers were not estimated for AOC 5 because there are no carcinogenic COCs in soil.

Future construction/utility workers may be potentially exposed to COCs through soil ingestion, soil dermal absorption, and dust inhalation. Construction/utility workers may also be exposed to COCs through dermal absorption of groundwater. The total adult worker HIs for the future construction/utility worker range from 8E-03 to 2E-02. Since the total HIs are less than unity, there is no concern for potential noncarcinogenic health effects for the future construction/utility worker at AOC 5. The total potential carcinogenic risk levels (RAE and RME) for the future construction/utility worker are both 2E-05. Since these risk estimates are within the target range (1E-04 to 1E-06), there is no potential unacceptable carcinogenic health risk associated with the future construction/utility worker.

<u>AOC 6</u>

The potential risks associated with AOC 6 are presented in Table 8-23.

Exposure to current maintenance workers was not evaluated because there is no surface contamination and because there are no volatile organic COCs at AOC 6.

Future maintenance workers may be potentially exposed to COCs through soil ingestion, soil dermal absorption, and dust inhalation. The total adult worker HIs for the future maintenance worker range from 4E-04 to 9E-04. Since the total HIs are less than unity, there is no concern for potential noncarcinogenic health effects for the future maintenance worker at AOC 6. The total potential carcinogenic risk levels for the future maintenance worker range from 4E-07 to 1E-06. Since these risk estimates are below the target range (1E-04 to 1E-06), there is no potential unacceptable carcinogenic health risk associated with the future maintenance worker.

Future Facility workers may be potentially exposed to COCs through soil ingestion, soil dermal absorption, and dust inhalation. The total adult worker HIs for the future Facility worker range from 4E-03 to 9E-03. Since the total HIs are less than unity, there is no concern for potential noncarcinogenic health effects for the future Facility worker at AOC 6. The total potential carcinogenic risk levels for the future Facility worker range from 4E-06 to 1E-05. Since these risk estimates are within the target range (1E-04 to 1E-06), there is no potential unacceptable carcinogenic health risk associated with the future Facility worker.

Future construction/utility workers may be potentially exposed to COCs through soil ingestion, soil dermal absorption, and dust inhalation. Construction/utility workers may also be exposed to COCs through dermal absorption of groundwater. The total adult worker HIs for the future construction/utility worker range from 2E-02 to 4E-02. Since the total HIs are less than unity, there is no concern for potential noncarcinogenic health effects for the future construction/utility worker at AOC 6. The total potential carcinogenic risk levels (RAE and RME) for the future construction/utility worker are both 2E-05. Since these risk estimates are within the target range (1E-04 to 1E-06), there is no potential unacceptable carcinogenic health risk associated with the future construction/utility worker.

AOC 7

The potential risks associated with AOC 7 are presented in Table 8-24.

Exposure to current maintenance workers was not evaluated because there is no surface contamination and because there are no volatile organic COCs at AOC 7.

Future maintenance workers may be potentially exposed to COCs through soil ingestion, soil dermal absorption, and dust inhalation. The total adult worker HIs for the future maintenance worker range from 3E-04 to 6E-04. Since the total HIs are less than unity, there is no concern for potential noncarcinogenic health effects for the future maintenance worker at AOC 7. The total potential carcinogenic risk levels for the future maintenance worker range from 8E-08 to 1E-07. Since these risk estimates are below the target range (1E-04 to 1E-06), there is no potential unacceptable carcinogenic health risk associated with the future maintenance worker.

Future Facility workers may be potentially exposed to COCs through soil ingestion, soil dermal absorption, and dust inhalation. The total adult worker HIs for the future Facility worker range from 3E-03 to 6E-03. Since the total HIs are less than unity, there is no concern for potential noncarcinogenic health effects for the future Facility worker at AOC 7. The total potential carcinogenic risk levels for the future Facility worker range from 6E-07 to 9E-07. Since these risk estimates are below the target range (1E-04 to 1E-06), there is no potential unacceptable carcinogenic health risk associated with the future Facility worker.

Future construction/utility workers may be potentially exposed to COCs through soil ingestion, soil dermal absorption, and dust inhalation. Construction/utility workers may also be exposed to COCs through dermal absorption of groundwater. The total adult worker HIs for the future construction/utility worker range from 2E-02 to 3E-02. Since the total HIs are less than unity, there is no concern for potential noncarcinogenic health effects for the future construction/utility worker at AOC 7. The total potential carcinogenic risk levels (RAE and RME) for the future construction/utility worker are both 2E-05. Since these risk estimates are within the target range (1E-04 to 1E-06), there is no potential unacceptable carcinogenic health risk associated with the future construction/utility worker.

AOC 8

The potential risks associated with AOC 8 are presented in Table 8-25.

Current Facility workers may be potentially exposed to volatile COCs from the subsurface through the vapor inhalation pathway. The total adult worker HIs for the current Facility worker range from 1E-02 to 2E-02. Since the total HIs are less than unity, there is no concern for potential noncarcinogenic health effects for the current Facility worker at AOC 8. The total potential carcinogenic risk level for the current Facility worker is 2E-07. Since this cancer risk estimate is below the target range (1E-04 to 1E-06), there is no potential unacceptable carcinogenic health risk associated with the current Facility worker at AOC 8.

Future maintenance workers may be potentially exposed to COCs through soil ingestion, soil dermal absorption, dust inhalation and vapor inhalation. The total adult worker HIs for the future maintenance worker range from 1E-02 to 2E-02. Since the total HIs are less than unity, there is no concern for potential noncarcinogenic health effects for the future maintenance worker at AOC 8. The total potential carcinogenic risk level for the future maintenance worker is 2E-07. Since this risk estimate is below the target range (1E-04 to 1E-06), there is no potential unacceptable carcinogenic health risk associated with the future maintenance worker.

Future Facility workers may be potentially exposed to COCs through soil ingestion, soil dermal absorption, dust inhalation and vapor inhalation. The total adult worker HIs for the future Facility worker range from 4E-02 to 6E-02. Since the total HIs are less than unity, there is no concern for potential noncarcinogenic health effects for the future maintenance worker at AOC 8. The total potential carcinogenic risk level for the future Facility worker is 8E-07. Since this risk estimate is below the target range (1E-04 to 1E-06), there is no potential unacceptable carcinogenic health risk associated with the future Facility worker.

Future construction/utility workers may be potentially exposed to COCs through soil ingestion, soil dermal absorption, dust inhalation and vapor inhalation. Construction/utility workers may also be exposed to COCs through dermal absorption of groundwater. The total adult worker HIs for the future construction/utility worker range from 3E-01 to 4E-01. Since the total HIs are less than unity, there is no concern for potential noncarcinogenic health effects for the future construction/utility worker at AOC 1. The total potential carcinogenic risk level for the future construction/utility worker is 2E-05. Since this risk estimate is within the target range (1E-04 to 1E-06), there is no potential for unacceptable carcinogenic health risks associated with the future construction/utility worker.

Cumulative Risks For Maintenance Workers

Since the maintenance worker may be exposed to multiple source areas, the risks associated with this exposure scenario at each source area are considered additive. A summary of the risks for the current and future maintenance worker at the Facility is presented in Tables 8-26 and 8-27, respectively.

Current maintenance workers may be exposed to COCs at SWMUs F, G and H. The total cumulative adult worker HIs for the current maintenance worker range from 2E+00 to 2E+01. Since the total cumulative HIs exceed unity, there is a concern for potential cumulative noncarcinogenic health effects for the current maintenance worker. The total potential carcinogenic risk levels for the current maintenance worker range from 7E-05 to 6E-04. Since these cancer risk estimates exceed the target range (1E-04 to 1E-06), there is a potential cumulative unacceptable carcinogenic health risk associated with the current maintenance worker. This analysis suggests that SWMU H accounts for nearly 100 percent of the total cumulative noncarcinogenic and carcinogenic risk estimates for the current maintenance worker.

Future maintenance workers may be exposed to COCs at SWMUs F, G, and H, as well as at AOCs 1, 2, 4, 5, 6, 7, and 8. The total cumulative adult worker HIs for the future maintenance worker range from 1E+01 to 9E+01. Since the total cumulative HIs exceed unity, there is a concern for potential cumulative noncarcinogenic health effects for the future maintenance worker. The total potential carcinogenic risk levels for the future maintenance worker range from 4E-04 to 2E-03. Since these cancer risk estimates exceed the target range (1E-04 to 1E-06), there is a potential cumulative unacceptable carcinogenic risk associated with the future maintenance worker. This analysis suggests that SWMU H accounts for approximately 99 percent of the total cumulative noncarcinogenic and carcinogenic risks estimates for the future maintenance worker.

Recreational User Preliminary Risk Estimates

Recreational users of the Detroit River may be exposed to concentrations of the COCs in surface water. Exposures may occur through ingestion and dermal absorption of COCs in surface water. The total potential noncarcinogenic and carcinogenic risks associated with these human health exposures are summarized in Table 8-28.

The total adult and child recreational user HIs range from 7E-08 to 1E-07, and from 2E-07 to 4E-07, respectively. Since the pathway specific and total HIs are less than unity, there is no concern for potential noncarcinogenic health effects. The total recreational user potential lifetime carcinogenic health risk levels (RAE and RME) are both 3E-09. Since each cancer risk estimate is below the acceptable range (1E-04 to 1E-06), there is no potential unacceptable carcinogenic health risk associated with future recreational use of the Detroit River.

8.4.2 Preliminary Ecological Risks

The preliminary evaluation of potential adverse effects on ecological receptors associated with the COCs detected at the identified source areas includes a characterization of, habitats and species associations.

The approach used in this assessment consisted of a literature review, field reconnaissance, and interviews with local experts, resulting in the development of habitat descriptions and species associations for each identified source area within the Facility. No actual biota sampling programs were conducted as part of this investigation. Due to limitations in the available information, this assessment should not be considered to encompass all aspects of the potential ecological effects of the COCs.

The site characterization was conducted by QST biologists who performed a walkover of the site. Terrestrial habitat characterization was largely based upon the identification of predominant vegetation communities within the areas surrounding the study site. Plant identification was accomplished in the field. Incidental observations of fauna were recorded in the field. State (MDNR) and federal (USFWS) agencies were contacted for information on species of special concern.

Habitat types for the Facility include both terrestrial and aquatic types. Terrestrial habitats are dominated by open areas primarily inhabited by grasses. Aquatic habitats include a small man-made impoundment located near the southeast corner of the site and the Trenton Channel of the Detroit River which makes up the East boundary of the project area.

Vegetative cover primarily consists of grasses and a small number of trees or shrubs. Grasslands dominate the landscape by covering greater than 50 percent of the overall acreage for the Facility. Local grasses or weeds consist primarily of wild carrot, clover, dandelion, and wild strawberry. The extent of successional change and the stage of vegetative development has been greatly influenced by human activities. Seed grass has been historically planted on the site, however, pioneering grass and weeds have since taken over the vegetative canopy. Poor soil quality has contributed to the lack of seed grasses found at the site. Soil consisting of high pH was used as fill at one time and has resulted in the invasion by more tolerant pioneering weed species.

Trees and shrubs located on the site primarily consist of ornamental species. Plant diversity appears to be highest near the shoreline area where weed species such as: cottonwood, box elder, American elm, dogwood, willow, goldenrod, red-osier, deadly night shade, sumac, gray dogwood, wild rose, reed grass, and wild grape can be found (Woodward-Clyde, 1994).

Wildlife diversity is relatively low due to the lack of good cover and food availability. The most abundant group observed at the site were birds. Dominant bird species at the site included Canada geese and herring gulls which on occasion, numbered well into the hundreds. Open water or shoreline habitat were utilized the most by a variety of birds such as: Canada geese, herring gull, killdeer, mallard, great blue heron, double crested cormorant, and spotted sand piper. Other bird species observed at the site included: barn swallow, European starling, English sparrow, common barn pigeon, mourning dove, common crow, and sparrow hawk.

Terrestrial habitat loss has occurred as a result of industrial growth and urban development. The lack of habitat at the site limited terrestrial animal inhabitation. Mammal species were considerably less diverse with only woodchuck and cottontail rabbit being observed. Other species including whitetail deer, coyote, and fox may inhabit the site on rare or transient occasions.

Aquatic habitats include the Trenton Channel of the Detroit River and a small man-made impoundment. The Trenton Channel of the Detroit River connects Lake St. Clair with Lake Erie. The Detroit River flow regime is complex in part to the presence of numerous islands and channels. Flow is greatly influenced by fluctuations in water levels of Lake Erie. Channel width ranges between 2,500 to 5,000 feet wide with a drop in elevation of 3 feet over its 31.7 mile length. Channel depths range between 30 to 50 feet with an average flow rate of 185,000 ft^3/sec. The impoundment is relatively small with a depth approximately less than ten feet deep. The impoundment may provide habitat for various aquatic insects (i.e., chironomids, mayflies, dragonflies), crayfish, herpetofaunal species, and waterfowl.

Detroit River fish species are a mixture of natural and introduced species. Historical records indicate that approximately 60 natural species either reside, spawn, or migrate into the lower half of the river (Woodward-Clyde, 1994). Species endemic to the river include walleye, perch, bluegills, suckers, catfish, and numerous shiners and minnows. Introduced species include common carp, rainbow smelt, alewife, and sea lamprey.

For the purpose of this investigation, a "sensitive" resource is defined as an element of either biotic or physical nature that has been historically documented as occurring within the general area of the site. Examples of sensitive resources, therefore, are federal and state listed threatened or endangered species and any natural community that is considered to be sensitive/unique based upon its biological composition and/or the relative rarity of similar community types within the state, region, or country.

Rare, threatened or endangered plant or animal species have not been observed at the Facility (ERM, 1991). However, the Michigan Department of Natural Resources (MDNR) has provided a list of fish and mussel species potentially present adjacent to the site. Fish species of special concern include the silver chub (special concern), lake sturgeon (threatened), and northern madtom (endangered). Mussel species of special concern consist of the northern riffleshell (endangered federally), snuffbox (endangered), round hickorynut (endangered), and the purple wartyback (special concern). These riverine species are sensitive to disturbance of their environment, and have been known to be affected by dredging, siltation, chemical contamination, and surface runoff. No field surveys were conducted to specifically search for such resources.

Potential environmental risks to aquatic receptors are quantified by comparing the estimated media exposure concentrations derived in Section 8.2. This comparison is described as an Ecotoxicity Quotient (EQ) which can be expressed as:

$$EQ = \frac{C_{med}}{TC_{med}}$$

where: C_{med} = Concentration of the constituent in the medium (i.e., mg/L), and
TC_{med} = Toxicity criteria for the constituent in the same medium (i.e., mg/L).

If the constituent concentration exceeds the toxicity criteria, then the potential for an adverse ecological effect is suggested. If the EQ exceeds unity, the species of concern may be at risk to an adverse effect from that constituent.

In addition, a cumulative EQ (EQ_{cum}) is developed to determine whether a species of concern will receive excessive exposure to a mixture of constituents from each route of exposure and is developed as follows:

$$EQ_{cum} = EQ_{const\,A} + EQ_{const\,B} + EQ_{const\,C} + \ldots + EQ_{const\,X}$$

If the EQ_{cum} is greater than 1.0, it is suggested that the total exposure to all constituents of concern through all exposure pathways is sufficient to produce a potential risk of adverse effects to the species of concern.

The critical toxicity values presented in Section 8.3 incorporate a number of safety factors, and wherever possible, conservative assumptions (i.e., assumptions that would over-estimate the dose) were made in the exposure assessment. Therefore, an EQ that exceeds unity (i.e., EQ > 1.0) does not necessarily indicate that an adverse effect will occur.

The potential ecological risk estimates associated with the Facility are presented in Table 8-29. Ecological receptors (aquatic life) in the Detroit River may be exposed to COCs in surface water discharging from groundwater.

The total cumulative aquatic life EQs for surface water exposure are estimated to range from 3E-03 to 5E-03. Since these estimates are less than unity, there is no potential for unacceptable ecological risks to aquatic life in the Detroit River.

8.4.3 Uncertainties Associated with the Preliminary Risk Assessment

The goal of an uncertainty analysis in a risk assessment is to provide to the appropriate decision-makers (i.e., risk managers) a wide range of information about risk assessment assumptions, their inherent uncertainty and variability, and the effect of uncertainty and variability on the estimate of risk. This subsection discusses the uncertainties in the preliminary risk analysis for the Facility. The major impact of the uncertainty analysis is that the predicted potential risks are relative in nature and do not represent an absolute quantification. This is an important point that is vital to the proper interpretation and understanding of the potential risks presented in this report.

For any potential risk to exist, both exposure to the constituents of concern and toxicity at the predicted exposure levels must be present. The risk equation requires an estimation of the dose that a hypothetical individual might receive from constituents associated with the Facility. As discussed in earlier sections, exposure scenarios were developed to allow calculation of the exposure and ultimately the potential risk. These exposure scenarios are based on a number of assumptions that are common or standard in most risk assessments of this type. These assumptions are designed to be conservative and may likely over-estimate exposure. The following paragraphs discuss these exposure assumptions in some detail.

A number of assumptions were made in this risk analysis that are designed to over-estimate exposure in areas where the available data make more specific quantification difficult or impossible. It is inherent in these assumptions that the actual case would clearly result in lower exposure relative to the hypothetical. The assumptions are presented in detail in Appendix G. The exposure estimates include assumptions concerning exposure point concentrations, fate and transport modeling, and pathway specific exposure parameters. Each category of assumption has an effect resulting in either an over- or under-estimation of potential risk at the Facility.

The data available to characterize the COCs at each source area included a large percentage of non-detected samples with elevated detection limits. When a constituent was not detected in a sample, half of the detection limit was used in the calculation of the mean and UCL_{95} concentrations for that constituent. Consequently, the maximum concentrations detected were frequently much lower than the calculated UCL_{95} concentrations. In addition, for purposes of this analysis, it was assumed that the constituent concentrations were distributed lognormally. If any of the constituent concentrations actually fit a normal distribution, the UCL_{95} concentration could be lower than the UCL_{95} values calculated. Consequently, these assumptions combine to result in an over-estimation of potential risk.

Data were not available for several exposure pathways which were quantified in this preliminary risk assessment. Constituents in air (dust and vapors) were not measured. In addition, groundwater data were used to predict surface water concentrations downgradient of the site. The use of models and other assumptions to calculate constituent concentrations increases data uncertainty. Generally, the models used are conservative and tend to predict higher concentrations in dust, vapors and surface water than would likely occur over time. As a result of these conservative assumptions, the potential risks to some human receptors may have been over-estimated by one or two orders of magnitude and have a high degree of uncertainty associated with the analysis.

Exposure associated with the future construction/utility worker scenario may have also contributed to an overestimate of risk. The soil ingestion rate of 480 mg/day for the construction/utility worker is much higher than would actually be expected. While the construction/utility worker is expected to come into direct contact with contaminated soils, actual exposure through soil ingestion is only anticipated to occur through incidental hand to mouth contact. Actual soil ingestion for the construction/utility worker is expected to be only slightly higher than the typical worker ingestion rate of 50 mg/day. Consequently, construction/utility worker risks associated with the soil ingestion pathway may have been overestimated.

In addition to the exposure assumptions, certain assumptions related to the human health and ecological toxicity assessment also contribute to uncertainty in this preliminary risk assessment. The human health toxicological uncertainties primarily relate to the methodology by which both carcinogenic and noncarcinogenic criteria are developed. The no-threshold theory of cancer development assumes that there is no "safe" level of exposure to any constituent that has been shown or suspected to cause cancer. The assumption is that even if relatively large doses of a constituent were required to cause cancer in laboratory animals, the data can be extrapolated down many orders of magnitude to estimate slope factors for humans. The logic behind this assumption is that it is not known if a threshold exists (an uncertainty), the proper approach is to assume a worst-case theory of cancer formation so that it is very unlikely that the risk can be under-estimated. With the noncarcinogenic criteria, a variety of uncertainty factors are typically applied to existing data to determine levels at which no effects are expected. The application of order of magnitude uncertainty factors results in a likelihood that potential risks will be over-estimated.

Overall, there is a high potential that this preliminary risk assessment has resulted in an over-estimation of potential human health and ecological risks at the Facility.

TABLE 8-1

Summary of Soil Analytical Data for Constituents of Concern at SWMU F
BASF - Wyandotte RFI

Constituent of Concern	Units	Detection Frequency	Minimum Hit	Maximum Hit	Mean	Standard Deviation	95% UCL*
Volatile Organics							
Benzene	ug/kg	10%	2000	2000	1,042.0	1,013.6	787,955
1,2-Dichloropropane	ug/kg	50%	4.2	70000	9,598.0	21,570.0	494,229,241
Toluene	ug/kg	70%	11	110000	24,208.2	36,589.8	12,117,210,957
m-Xylene & p-Xylene	ug/kg	10%	8.1	8.1	1,022.4	994.0	338,105
Semi-Volatile Organics							
Acenaphthene	ug/kg	10%	440	440	3,002.0	3,861.4	37,096
Benzo(a)anthracene	ug/kg	40%	120	1700	3,148.5	3,778.1	49,799
Benzo(a)pyrene	ug/kg	30%	120	1600	3,059.5	3,834.1	55,148
Benzo(b)fluoranthene	ug/kg	40%	150	1500	3,113.5	3,791.5	38,366
Benzo(ghi)perylene	ug/kg	30%	59	850	2,992.4	3,870.2	94,936
Benzo(k)fluoranthene	ug/kg	40%	82	890	2,945.7	3,902.2	85,959
Benzyl alcohol	ug/kg	10%	21000	21000	4,393.0	6,803.7	79,861
bis(2-Chloroisopropyl) ether	ug/kg	60%	290	28000	5,775.5	9,102.9	108,628
Chrysene	ug/kg	40%	160	1700	3,128.5	3,789.3	43,309
2,4-Dimethylphenol	ug/kg	10%	22000	22000	5,138.0	7,021.8	151,081
Indeno(1,2,3-cd)pyrene	ug/kg	10%	100	100	3,024.5	3,848.4	57,154
2-Methylnaphthalene	ug/kg	30%	130	730	3,007.5	3,860.2	58,742
2-Methylphenol	ug/kg	10%	4100	4100	3,348.0	3,778.0	49,505
4-Methylphenol	ug/kg	40%	200	20000	4,971.0	6,471.4	107,465
Naphthalene	ug/kg	40%	99	450	2,904.4	3,928.2	74,056
Pentachlorophenol	ug/kg	20%	16	64	11.6	18.8	25
Phenanthrene	ug/kg	40%	200	6000	3,660.5	3,772.9	50,421
Pesticides							
Aroclor 1254	ug/kg	13%	2800	2800	599.4	891.3	1,423
4,4'-DDE	ug/kg	13%	7.8	7.8	13.4	10.2	61
Metals/Inorganics							
Antimony	mg/kg	30%	0.71	16	2.08	4.89	5
Arsenic	mg/kg	100%	4.4	63.9	23.23	22.27	63
Chromium	mg/kg	100%	6.4	130	23.84	37.59	48
Cobalt	mg/kg	10%	40.5	40.5	8.12	11.43	14
Copper	mg/kg	100%	10.5	7710	793.20	2,430.36	7,623
Lead	mg/kg	100%	1.5	876	109.46	270.19	1,585
Mercury	mg/kg	60%	0.33	21.1	2.90	6.50	122
Nickel	mg/kg	90%	6.4	170	28.20	50.18	66
Total Cyanide (3)	mg/kg	80%	1.1	5.1	2.20	1.69	12
Zinc	mg/kg	90%	34.7	1000	163.35	296.72	1,093

* 95% UCL is calculated based on the assumption that the data is lognormally distributed.

TABLE 8-2

Summary of Soil Analytical Data for Constituents of Concern at SWMU G
BASF - Wyandotte RFI

Constituent of Concern	Units	Detection Frequency	Minimum Hit	Maximum Hit	Mean	Standard Deviation	95% UCL*
Semi-Volatile Organics							
Acenaphthene	ug/kg	20%	38	43	394.60	553.33	1,530
Benzo(a)anthracene	ug/kg	90%	390	3200	804.00	858.99	1,411
Benzo(a)pyrene	ug/kg	90%	310	3700	801.00	1,039.32	1,501
Benzo(b)fluoranthene	ug/kg	90%	600	4500	1,200.00	1,203.12	2,408
Chrysene	ug/kg	90%	350	3600	835.00	1,003.81	1,611
Indeno(1,2,3-cd)pyrene	ug/kg	80%	140	1800	541.00	678.58	1,272
Pentachlorophenol	ug/kg	30%	39	620	118.25	207.62	916
Phenanthrene	ug/kg	100%	87	1900	781.70	570.35	1,977
Pesticides							
Aroclor 1260	ug/kg	50%	370	1100	386.50	373.27	1,060
Metals/Inorganics							
Arsenic	mg/kg	100%	4.8	101	26.61	31.81	74.8
Lead	mg/kg	100%	11	238	73.13	67.68	185.5
Mercury	mg/kg	80%	0.14	5.4	0.77	1.64	3.6
Total Cyanide	mg/kg	20%	0.043	0.66	0.19	0.17	0.3

* 95% UCL is calculated based on the assumption that the data is lognormally distributed.

TABLE 8-3

Summary of Soil Analytical Data for Constituents of Concern at SWMU H
BASF - Wyandotte RFI

Constituent of Concern	Units	Detection Frequency	Minimum Hit	Maximum Hit	Mean	Standard Deviation	95% UCL*
Volatile Organics							
Acetone	ug/kg	70%	20	1600	393,701	1,232,015	1.54E+11
Benzene	ug/kg	10%	780	780	95,556	300,223	7.49E+12
Chlorobenzene	ug/kg	10%	830	830	95,561	300,221	7.85E+12
1,2-Dichlorobenzene	ug/kg	10%	680	680	95,546	300,226	6.78E+12
1,2-Dichloropropane	ug/kg	80%	4	50000000	5,028,306	15,801,540	3.77E+23
Ethylbenzene	ug/kg	10%	470	470	95,525	300,233	5.32E+12
Methyl ethyl ketone	ug/kg	10%	31	31	393,700	1,232,015	1.40E+12
m-Xylene & p-Xylene	ug/kg	10%	1500	1500	49,133	153,151	2.06E+12
o-Xylene	ug/kg	10%	570	570	48,930	153,222	4.73E+11
Toluene	ug/kg	20%	13	5800	96,058	300,051	4.60E+13
1,2,3-Trichloropropane	ug/kg	20%	3900	17000	97,148	299,709	1.47E+14
Semi-Volatile Organics							
Acenaphthene	ug/kg	20%	1900	6700	11,786	32,818	470,310
Benzo(a)anthracene	ug/kg	20%	250	4500	11,404	32,920	320,769
Benzo(a)pyrene	ug/kg	20%	210	3100	11,260	32,957	268,159
Benzo(b)fluoranthene	ug/kg	20%	380	4200	11,387	32,922	286,079
Benzo(ghi)perylene	ug/kg	10%	180	180	11,897	32,844	616,258
Benzo(k)fluoranthene	ug/kg	10%	130	130	11,892	32,846	697,983
bis(2-Chloroethyl) ether	ug/kg	10%	12000	12000	12,153	32,831	690,277
bis(2-Chloroisopropyl) ether	ug/kg	70%	130	1400000	156,397	438,837	4,852,668,627
bis(2-Ethylhexyl) phthalate	ug/kg	20%	1900	10000	12,119	32,777	612,925
4-Chloro-3-methylphenol	ug/kg	10%	3200	3200	12,196	32,740	740,230
2-Chlorophenol	ug/kg	10%	3000	3000	12,176	32,746	719,704
Chrysene	ug/kg	20%	280	4800	11,437	32,912	326,535
2,4-Dimethylphenol	ug/kg	10%	8300	8300	11,783	32,854	502,871
2,4-Dinitrotoluene	ug/kg	10%	2400	2400	12,116	32,765	658,723
Fluoranthene	ug/kg	20%	270	11000	12,056	32,832	623,333
Indeno(1,2,3-cd)pyrene	ug/kg	10%	150	150	11,894	32,846	658,462
2-Methylnaphthalene	ug/kg	20%	120	6400	11,581	32,886	524,174
4-Methylphenol	ug/kg	10%	4900	4900	11,443	32,911	340,770
Naphthalene	ug/kg	20%	93	16000	12,538	32,860	1,337,605
4-Nitrophenol	ug/kg	10%	4500	4500	57,260	156,238	2,518,597
N-Nitrosodi-n-propylamine	ug/kg	10%	1900	1900	12,066	32,782	609,148
Pentachlorophenol	ug/kg	40%	10	300	57.28	99.34	568
Phenanthrene	ug/kg	20%	300	20000	12,959	32,922	1,081,322
1,2,4-Trichlorobenzene	ug/kg	10%	1900	1900	12,066	32,782	609,148
Pesticides							
alpha-Chlordane	ug/kg	10%	40	40	6.66	11.94	24
Aroclor 1248	ug/kg	10%	1600	1600	290.40	469.56	1,480
Aroclor 1254	ug/kg	10%	1200	1200	263.40	339.60	1,097
Metals/Inorganics							
Antimony	mg/kg	30%	15.3	52.2	11.59	20.34	1,340
Arsenic	mg/kg	100%	1.9	331	80.62	135.98	4,114
Beryllium	mg/kg	30%	0.91	7.6	1.84	2.99	8
Cadmium	mg/kg	90%	0.26	8.4	2.34	3.31	31
Chromium	mg/kg	100%	6.7	195	47.13	54.30	108
Cobalt	mg/kg	80%	9.6	75.3	22.00	27.44	68
Copper	mg/kg	100%	2.9	221	50.21	65.31	211
Lead	mg/kg	100%	2.7	433	74.14	134.56	782
Mercury	mg/kg	40%	0.14	52.9	5.69	16.60	334
Nickel	mg/kg	100%	5.7	103	44.91	36.47	120
Selenium	mg/kg	30%	1.4	295	58.09	121.48	71,659
Silver	mg/kg	30%	7.4	21.7	4.26	6.84	24
Thallium	mg/kg	20%	266	282	55.38	115.28	14,191
Total Cyanide	mg/kg	50%	0.019	16	2.54	5.13	112
Vanadium	mg/kg	100%	8.7	87.5	42.27	25.61	77

* 95% UCL is calculated based on the assumption that the data is lognormally distributed.

TABLE 8-4

Summary of Soil Analytical Data for Constituents of Concern at AOC 1
BASF - Wyandotte RFI

Constituent of Concern	Units	Detection Frequency	Minimum Hit	Maximum Hit	Mean	Standard Deviation	95% UCL*
Volatile Organics							
Benzene	ug/kg	56%	34	1,070,000	40,540.96	205,766.27	28,574
Ethylbenzene	ug/kg	52%	47	377,000	16,026.70	72,411.20	86,364
Styrene	ug/kg	44%	62	121,000	8,545.74	25,162.29	212,763
Toluene	ug/kg	93%	78	493,000	39,488.41	104,220.51	2,569,659
Xylene	ug/kg	59%	35	225,000	8,552.11	43,259.13	3,900

* 95% UCL is calculated based on the assumption that the data is lognormally distributed.

TABLE 8-5

Summary of Soil Analytical Data for Constituents of Concern at AOC 2
BASF - Wyandotte RFI

Constituent of Concern	Units	Detection Frequency	Minimum Hit	Maximum Hit	Mean	Standard Deviation	95% UCL*
Semi-Volatile Organics							
2-Methylnaphthalene	ug/kg	50%	290	3400	702.50	1,110.11	2,453
Naphthalene	ug/kg	50%	580	2500	695.00	787.99	2,467
Phenanthrene	ug/kg	75%	97	1200	515.25	471.39	2,119
Metals/Inorganics							
Arsenic	mg/kg	100%	0.73	41	18.07	13.80	217
Chromium	mg/kg	100%	5.3	101	24.86	34.59	115
Mercury	mg/kg	63%	0.15	17.1	2.40	5.95	175
Total Cyanide	mg/kg	75%	1	46	10.45	16.03	7,109
Zinc	mg/kg	100%	18.5	966	176.78	320.95	1,011

* 95% UCL is calculated based on the assumption that the data is lognormally distributed.

TABLE 8-6

Summary of Soil Analytical Data for Constituents of Concern at AOC 4
BASF - Wyandotte RFI

CONSTITUENT	UNITS	Detection Frequency	Minimum Hit	Maximum Hit	Mean
Volatile Organics					
Benzene	ug/kg	100%	250000	680000	465,000
Styrene	ug/kg	100%	96000	240000	168,000
Toluene	ug/kg	100%	190000	590000	390,000
m-Xylene & p-Xylene	ug/kg	100%	170000	740000	455,000
o-Xylene	ug/kg	50%	170000	240000	162,500
Semi-Volatile Organics					
Acenaphthylene	ug/kg	100%	1000000	9300000	5,150,000
Anthracene	ug/kg	100%	870000	7100000	3,985,000
Benzo(a)anthracene	ug/kg	100%	490000	4900000	2,695,000
Benzo(b)fluoranthene	ug/kg	100%	410000	4400000	2,405,000
Benzo(k)fluoranthene	ug/kg	100%	190000	2500000	1,345,000
Benzo(ghi)perylene	ug/kg	50%	1100000	1500000	1,025,000
Benzo(a)pyrene	ug/kg	100%	330000	4100000	2,215,000
Chrysene	ug/kg	100%	470000	5200000	2,835,000
Dibenzofuran	ug/kg	100%	740000	5900000	3,320,000
Fluoranthene	ug/kg	100%	1600000	14000000	7,800,000
Fluorene	ug/kg	100%	1200000	9500000	5,350,000
Indeno(1,2,3-cd)pyrene	ug/kg	100%	120000	1600000	860,000
2-Methylnaphthalene	ug/kg	100%	940000	9000000	4,970,000
3-Methylphenol	ug/kg	100%	230000	2700000	1,465,000
4-Methylphenol	ug/kg	100%	230000	2700000	1,465,000
Naphthalene	ug/kg	100%	6000000	48000000	27,000,000
Phenanthrene	ug/kg	100%	2700000	23000000	12,850,000
Phenol	ug/kg	50%	1100000	2300000	1,425,000
Pyrene	ug/kg	100%	1100000	9900000	5,500,000
Metals/Inorganics					
Arsenic	mg/kg	100%	14.5	20.5	17.5
Lead	mg/kg	100%	12.5	33.5	65.9
Selenium	mg/kg	100%	1.4	1.4	3.1
Thallium	mg/kg	100%	0.73	1.2	10.6
Total Cyanide	mg/kg	100%	3.4	3.7	15.0

Note: The standard deviation and 95% UCL were not calculated due to inadequate data.

TABLE 8-7

Summary of Soil Analytical Data for Constituents of Concern at AOC 5
BASF - Wyandotte RFI

CONSTITUENT	UNITS	Detection Frequency	Minimum Hit	Maximum Hit	Mean	Standard Deviation	95% UCL*
Semi-Volatile Organics							
2-Methylnaphthalene	ug/kg	19%	480	5500	654	1,305	889.9
4-Methylphenol	ug/kg	13%	1600	2100	470	555	675.7

* 95% UCL is calculated based on the assumption that the data is lognormally distributed.

TABLE 8-8

Summary of Soil Analytical Data for Constituents of Concern at AOC 6
BASF - Wyandotte RFI

Constituent of Concern	Units	Detection Frequency	Minimum Hit	Maximum Hit	Mean	Standard Deviation	95% UCL*
Semi-Volatile Organics							
Acenaphthene	ug/kg	0.25	55	510	955.63	1,532.25	8,575
Acenaphthylene	ug/kg	0.88	58	5800	1,028.38	1,962.19	14,794
Benzo(a)anthracene	ug/kg	1.00	130	26000	4,868.75	8,790.02	411,889
Benzo(b)fluoranthene	ug/kg	1.00	150	28000	7,028.75	10,537.11	695,794
Benzo(k)fluoranthene	ug/kg	0.88	50	10000	2,468.13	3,529.69	133,333
Benzo(ghi)perylene	ug/kg	1.00	87	11000	2,872.13	4,694.07	274,393
Benzo(a)pyrene	ug/kg	1.00	120	21000	4,773.75	7,499.08	452,126
Chrysene	ug/kg	1.00	210	22000	4,671.25	7,549.68	189,732
Dibenz(a,h)anthracene	ug/kg	0.75	110	4600	1,118.13	1,712.80	14,644
2,4-Dimethylphenol	ug/kg	0.13	170	170	1,001.25	1,524.42	5,490
Fluoranthene	ug/kg	1.00	120	50000	8,443.75	17,098.90	1,274,140
Indeno(1,2,3-cd)pyrene	ug/kg	0.88	73	12000	2,992.25	4,793.62	288,294
2-Methylnaphthalene	ug/kg	0.63	49	800	1,159.88	1,458.41	13,395
2-Methylphenol	ug/kg	0.13	140	140	997.50	1,526.79	5,951
Naphthalene	ug/kg	0.75	43	4100	1,161.63	1,365.78	21,527
Phenanthrene	ug/kg	1.00	520	45000	7,315.00	15,514.11	150,949
Metals/Inorganics							
Arsenic	mg/kg	1.00	3.9	44.9	20.99	15.80	77
Chromium	mg/kg	1.00	3.9	53.2	16.59	17.27	61
Lead	mg/kg	1.00	6	308	71.33	105.74	979
Mercury	mg/kg	0.38	0.53	3.3	0.59	1.12	10
Nickel	mg/kg	0.88	5.3	33.9	15.04	11.94	51
Total Cyanide	mg/kg	0.63	0.49	2.4	0.83	0.78	5

* 95% UCL is calculated based on the assumption that the data is lognormally distributed.

TABLE 8-9

Summary of Soil Analytical Data for Constituents of Concern at AOC 7
BASF - Wyandotte RFI

Constituent of Concern	Units	Detection Frequency	Minimum Hit	Maximum Hit	Mean	Standard Deviation	95% UCL*
Metals/Inorganics							
Arsenic	mg/kg	100%	1.7	49.0	16.83	13.68	29.3
Chromium	mg/kg	100%	5.6	29.1	13.95	7.84	18.0
Lead	mg/kg	100%	2.8	335.0	51.65	81.39	112.4
Mercury	mg/kg	73%	0.1	4.8	0.92	1.30	3.2
Nickel	mg/kg	95%	6.4	89.9	16.85	17.34	22.0
Silver	mg/kg	5%	19.4	19.4	1.49	4.00	1.4
Zinc	mg/kg	100%	12.6	603.0	83.65	125.06	137.5
Total Cyanide	mg/kg	52%	0.3	5.7	1.21	1.58	2.8

* 95% UCL is calculated based on the assumption that the data is lognormally distributed.

TABLE 8-10

Summary of Soil Analytical Data for Constituents of Concern at AOC 8
BASF - Wyandotte RFI

Constituent of Concern	Units	Detection Frequency	Minimum Hit	Maximum Hit	Mean	Standard Deviation	95% UCL*
Volatile Organics							
Benzene	ug/kg	41%	27	1,070,000	32,186.51	183,400.91	12,958
Ethylbenzene	ug/kg	47%	4.9	377,000	12,895.15	64,581.46	64,217
Styrene	ug/kg	44%	62	121,000	6,883.98	22,581.31	123,186
Toluene	ug/kg	85%	13	493,000	35,473.63	95,260.51	5,319,042
Xylene	ug/kg	50%	31.1	225,000	6,962.02	38,544.16	3,040

* 95% UCL is calculated based on the assumption that the data is lognormally distributed.

TABLE 8-11

Summary of Groundwater Analytical Data for Perimeter and Non-Network Monitoring Wells
BASF - Wyandotte RFI

Constituent of Concern	Units	Detection Frequency	Minimum Hit	Maximum Hit	Mean	Standard Deviation	95% UCL*
Volatile Organics							
Benzene	ug/L	26%	0.12	2900	151.8	630.9	21.6
Chlorobenzene	ug/L	8%	0.47	75	3.6	12.1	2.3
Vinyl chloride	ug/L	8%	0.75	230	13.0	49.7	4.9
Semi-Volatile Organics							
Acenaphthene	ug/L	3%	2.7	2.8	12.4	27.1	12.8
Benzo(a)anthracene	ug/L	7%	1.9	15	12.9	27.0	13.9
Benzo(a)pyrene	ug/L	5%	4.8	10	12.7	27.1	13.4
Benzo(b)fluoranthene	ug/L	7%	1.9	12	12.8	27.1	13.6
bis(2-Chloroethyl) ether	ug/L	20%	6.4	120	15.2	25.1	20.0
bis(2-Chloroisopropyl) ether	ug/L	13%	1.6	39	25.4	53.3	28.8
Chrysene	ug/L	7%	1.8	10	12.7	27.1	13.6
2-Methylnaphthalene	ug/L	9%	1.2	110	17.9	33.7	22.6
4-Methylphenol	ug/L	48%	1.2	210	33.8	57.7	46.4
Naphthalene	ug/L	18%	1.3	65.5	15.4	28.9	18.7
o-Toluidine	ug/L	2%	86	86	26.3	54.8	28.5
Phenanthrene	ug/L	5%	1.4	3.05	12.3	27.2	12.7
Pyridine	ug/L	7%	2.7	41	25.1	53.9	26.7
Metals/Inorganics (Filtered)							
Arsenic	mg/L	62%	0.0062	0.57	0.090	0.160	0.199
Barium	mg/L	100%	0.024	1.8	0.338	0.410	0.480
Cadmium	mg/L	14%	0.0011	0.0031	0.001	0.001	0.001
Copper	mg/L	9%	0.011	0.058	0.008	0.009	0.008
Mercury	mg/L	9%	0.00026	0.008	0.0004	0.0011	0.0002
Nickel	mg/L	13%	0.041	0.31	0.037	0.051	0.037
Selenium	mg/L	17%	0.0052	0.027	0.004	0.005	0.005
Vanadium	mg/L	17%	0.031	1.1	0.092	0.253	0.068
Zinc	mg/L	19%	0.02	0.25	0.026	0.036	0.028
Metals/Inorganics (Unfiltered)							
Arsenic	mg/L	77%	0.0056	0.66	0.106	0.170	0.270
Barium	mg/L	100%	0.036	1.7	0.383	0.432	0.505
Cadmium	mg/L	25%	0.001	0.02	0.001	0.003	0.001
Copper	mg/L	48%	0.013	0.42	0.039	0.077	0.047
Lead	mg/L	46%	0.003	0.22	0.019	0.045	0.021
Mercury	mg/L	20%	0.00026	0.0069	0.0006	0.0015	0.0006
Nickel	mg/L	38%	0.041	0.31	0.056	0.064	0.065
Selenium	mg/L	22%	0.0054	0.021	0.005	0.004	0.005
Total Cyanide	mg/L	83%	0.005	46	3.098	10.106	8.615
Vanadium	mg/L	43%	0.02	1.2	0.105	0.242	0.116
Zinc	mg/L	40%	0.047	0.6	0.094	0.131	0.126

* 95% UCL is calculated based on the assumption that the data is lognormally distributed.

TABLE 8-12

NON-CARCINOGENIC AND CARCINOGENIC ORAL HUMAN HEALTH EFFECTS CRITERIA FOR SOIL AND GROUNDWATER COCs
BASF-WYANDOTTE RFI

CONSTITUENT	Chronic Oral RfD (mg/kg/day)	Subchronic Oral RfD (mg/kg/day)	Oral CSF $(mg/kg/day)^{-1}$	Carcinogenic Class
Acetone	1.0E-01 (i)	1.0E+00 (h)	NA	D
Benzene	1.7E-03 (r)	NA	2.9E-02 (i)	A
Chlorobenzene	2.0E-02 (i)	NA	NA	D
1,2-Dichlorobenzene	9.0E-02 (i)	NA	NA	D
1,2-Dichloropropane	1.1E-03 (r)	3.7E-03 (r)	6.8E-02 (h)	B2
Ethylbenzene	1.0E-01 (i)	NA	NA	D
Methyl Ethyl Ketone	6.0E-01 (i)	2.0E+00 (h)	NA	D
Styrene	2.0E-01 (i)	NA	NA	D
Toluene	2.0E-01 (i)	2.0E+00 (h)	NA	D
1,2,3-Trichloropropane	6.0E-03 (i)	6.0E-02 (h)	7.0E+00 (h)	B2
Vinyl Chloride	NA	NA	1.9E+00 (h)	A
Xylenes	2.0E+00 (i)	NA	NA	D
Acenaphthene	6.0E-02 (i)	6.0E-01 (h)	NA	D
Acenaphthylene	3.0E-02 (e)	3.0E-01 (e)	NA	D
Anthracene	3.0E-01 (i)	3.0E+00 (h)	NA	D
Benzo(a)anthracene	NA	NA	7.3E-01 (n)	B2
Benzo(a)pyrene	NA	NA	7.3E+00 (i)	B2
Benzo(b)fluoranthene	NA	NA	7.3E-01 (n)	B2
Benzo(k)fluoranthene	NA	NA	7.3E-02 (n)	B2
Benzo(g,h,i)perylene	3.0E-02 (e)	3.0E-01 (e)	NA	D
Benzyl alcohol	3.0E-01 (h)	1.0E+00 (h)	NA	D
bis(2-Chloroethyl) ether	NA	NA	1.1E+00 (i)	B2
bis(2-Chloroisopropyl) ether	4.0E-02 (i)	4.0E-02 (h)	7.0E-02 (h)	C
bis(2-Ethylhexyl) phthalate	2.0E-02 (i)	NA	1.4E-02 (i)	B2
4-Chloro-3-methylphenol	NA	NA	NA	D
2-Chlorophenol	5.0E-03 (i)	5.0E-02 (h)	NA	D
Chrysene	NA	NA	7.3E-03 (n)	B2
Dibenzofuran	4.0E-03 (n)	NA	NA	D
Diethyl phthalate	8.0E-01 (i)	8.0E+00 (h)	NA	D
2,4-Dimethylphenol	2.0E-02 (i)	2.0E-01 (h)	NA	D
2,4-Dinitrotoluene	2.0E-03 (i)	2.0E-03 (h)	6.8E-01 (i)	B2
Fluoranthene	4.0E-02 (i)	4.0E-01 (h)	NA	D
Fluorene	4.0E-02 (i)	4.0E-01 (h)	NA	D
Indeno(1,2,3-cd)pyrene	NA	NA	7.3E-01 (n)	B2
2-Methylnaphthalene	3.0E-02 (e)	NA	NA	D
2-Methylphenol	5.0E-02 (x)	5.0E-01 (h)	NA	D

e = estimated value based on most toxic non-carcinogenic PAH (pyrene)
i = IRIS, 1997
h = HEAST, 1997
n = provisional value (NCEA, 1996)
r = route to route extrapolation
x = withdrawn value

TABLE 8-12 (Continued)

NON-CARCINOGENIC AND CARCINOGENIC ORAL HUMAN HEALTH EFFECTS CRITERIA FOR SOIL AND GROUNDWATER COCs
BASF-WYANDOTTE RFI

CONSTITUENT	Chronic Oral RfD (mg/kg/day)	Subchronic Oral RfD (mg/kg/day)	Oral CSF $(mg/kg/day)^{-1}$	Carcinogenic Class
3-Methylphenol	5.0E-02 (x)	5.0E-01 (h)	NA	D
4-Methylphenol	5.0E-03 (h)	5.0E-03 (h)	NA	D
Naphthalene	4.0E-02 (n)	NA	NA	D
4-Nitrophenol	NA	NA	NA	D
N-Nitrosodi-n-propylamine	NA	NA	7.0E+00 (i)	B2
Pentachlorophenol	3.0E-02 (i)	3.0E-02 (h)	1.2E-01 (i)	B2
Phenanthrene	3.0E-02 (e)	3.0E-01 (h)	NA	D
Phenol	6.0E-01 (i)	6.0E-01 (h)	NA	D
Pyrene	3.0E-02 (i)	3.0E-01 (h)	NA	D
Pyridine	1.0E-03 (i)	1.0E-02 (h)	NA	D
o-Toluidine	NA	NA	9.2E+00 (h)	B2
1,2,4-Trichlorobenzene	1.0E-02 (i)	1.0E-02 (h)	NA	D
alpha Chlordane	6.0E-05 (i)	6.0E-05 (h)	1.3E+00 (i)	B2
Arochlor 1248	NA	NA	2.0E+00 (i)	B2
Arochlor 1254	2.0E-05 (i)	5.0E-05 (h)	2.0E+00 (i)	B2
Arochlor 1260	NA	NA	2.0E+00 (i)	B2
4,4-DDE	NA	NA	3.4E-01 (i)	B2
Antimony	4.0E-04 (i)	4.0E-04 (h)	NA	D
Arsenic	3.0E-04 (i)	3.0E-04 (h)	1.5E+00 (i)	A
Barium	7.0E-02 (i)	7.0E-02 (h)	NA	D
Beryllium	5.0E-03 (i)	5.0E-03 (h)	4.3E+00 (i)	B2
Cadmium	5.0E-04 (i)	NA	NA	B1
Chromium	5.0E-03 (i)	2.0E-02 (h)	NA	A
Cobalt	6.0E-02 (n)	NA	NA	D
Copper	3.7E-02 (h)	3.7E-02 (h)	NA	D
Cyanide	2.0E-02 (i)	2.0E-02 (h)	NA	D
Lead	NA	NA	NA	B2
Mercury	3.0E-04 (i)	NA	NA	D
Nickel	2.0E-02 (i)	2.0E-02 (h)	NA	A
Selenium	5.0E-03 (i)	5.0E-03 (h)	NA	D
Silver	5.0E-03 (i)	5.0E-03 (h)	NA	D
Thallium	8.0E-05 (i)	8.0E-04 (h)	NA	D
Vanadium	7.0E-03 (h)	7.0E-03 (h)	NA	D
Zinc	3.0E-01 (i)	3.0E-01 (h)	NA	D

e = estimated value based on most toxic non-carcinogenic PAH (pyrene)
i = IRIS, 1997
h = HEAST, 1997
n = provisional value (NCEA, 1996)
r = route to route extrapolation
x = withdrawn value

TABLE 8-13

NON-CARCINOGENIC AND CARCINOGENIC INHALATION HUMAN HEALTH EFFECTS CRITERIA FOR SOIL AND GROUNDWATER COCs
BASF-WYANDOTTE RFI

CONSTITUENT	Chronic Inhalation RfD (mg/kg/day)	Subchronic Inhalation RfD (mg/kg/day)	Inhalation CSF $(mg/kg/day)^{-1}$	Carcinogenic Class
Acetone	1.0E-01 (r)	NA	NA	D
Benzene	1.7E-03 (n)	NA	2.9E-02 (i)	A
Chlorobenzene	5.7E-03 (h)	NA	NA	D
1,2-Dichlorobenzene	5.7E-02 (h)	5.7E-01 (h)	NA	D
1,2-Dichloropropane	1.1E-03 (i)	3.7E-03 (h)	6.8E-02 (r)	B2
Ethylbenzene	2.9E-01 (i)	NA	NA	D
Methyl Ethyl Ketone	2.9E-01 (i)	2.9E-01 (h)	NA	D
Styrene	2.9E-01 (i)	8.6E-01 (h)	NA	D
Toluene	1.1E-01 (h)	NA	NA	D
1,2,3-Trichloropropane	5.0E-03 (r)	NA	7.0E+00 (r)	B2
Vinyl Chloride	NA	NA	3.0E-01 (h)	A
Xylenes	2.0E-01 (x)	NA	NA	D
Acenaphthene	6.0E-02 (r)	NA	NA	D
Acenaphthylene	3.0E-02 (r)	NA	NA	D
Anthracene	3.0E-01 (r)	NA	NA	D
Benzo(a)anthracene	NA	NA	7.3E-01 (r)	B2
Benzo(a)pyrene	NA	NA	7.3E+00 (r)	B2
Benzo(b)fluoranthene	NA	NA	7.3E-01 (r)	B2
Benzo(k)fluoranthene	NA	NA	7.3E-02 (r)	B2
Benzo(g,h,i)perylene	3.0E-02 (r)	NA	NA	D
Benzyl alcohol	3.0E-01 (r)	NA	NA	D
bis(2-Chloroethyl) ether	NA	NA	1.2E+00 (i)	B2
bis(2-Chloroisopropyl) ether	4.0E-02 (r)	NA	3.5E-02 (h)	C
bis(2-Ethylhexyl) phthalate	2.2E-02 (r)	NA	1.4E-02 (r)	B2
4-Chloro-3-methylphenol	NA	NA	NA	D
2-Chlorophenol	5.0E-03 (r)	NA	NA	D
Chrysene	NA	NA	7.3E-03 (r)	B2
Dibenzofuran	4.0E-03 (r)	NA	NA	D
Diethyl phthalate	8.0E-01 (r)	NA	NA	D
2,4-Dimethylphenol	2.0E-02 (r)	NA	NA	D
2,4-Dinitrotoluene	2.0E-03 (r)	NA	6.8E-01 (r)	B2
Fluoranthene	4.0E-02 (r)	NA	NA	D
Fluorene	4.0E-02 (r)	NA	NA	D
Indeno(1,2,3-cd)pyrene	NA	NA	7.3E-01 (r)	B2
2-Methylnaphthalene	3.0E-02 (r)	NA	NA	D
2-Methylphenol	5.0E-02 (r)	NA	NA	D

e = estimated value based on most toxic non-carcinogenic PAH (pyrene)
i = IRIS, 1997
h = HEAST, 1997
n = provisional value (NCEA, 1996)
r = route to route extrapolation
x = withdrawn value

TABLE 8-13 (Continued)

NON-CARCINOGENIC AND CARCINOGENIC INHALATION HUMAN HEALTH EFFECTS CRITERIA FOR SOIL AND GROUNDWATER COCs
BASF-WYANDOTTE RFI

CONSTITUENT	Chronic Inhalation RfD (mg/kg/day)	Subchronic Inhalation RfD (mg/kg/day)	Inhalation CSF $(mg/kg/day)^{-1}$	Carcinogenic Class
3-Methylphenol	5.0E-02 (r)	NA	NA	D
4-Methylphenol	5.0E-03 (r)	NA	NA	D
Naphthalene	4.0E-02 (r)	NA	NA	D
4-Nitrophenol	NA	NA	NA	D
N-Nitrosodi-n-propylamine	NA	NA	7.0E+00 (r)	B2
Pentachlorophenol	3.0E-02 (r)	NA	1.2E-01 (r)	B2
Phenanthrene	3.0E-02 (r)	NA	NA	D
Phenol	6.0E-01 (r)	NA	NA	D
Pyrene	3.0E-02 (r)	NA	NA	D
Pyridine	1.0E-03 (r)	NA	NA	D
o-Toluidine	NA	NA	9.2E+00 (r)	B2
1,2,4-Trichlorobenzene	5.7E-02 (h)	NA	NA	D
alpha Chlordane	6.0E-05 (r)	NA	1.3E+00 (i)	B2
Arochlor 1248	NA	NA	2.0E+00 (r)	B2
Arochlor 1254	2.0E-05 (r)	NA	2.0E+00 (r)	B2
Arochlor 1260	NA	NA	2.0E+00 (r)	B2
4,4-DDE	NA	NA	3.4E-01 (r)	B2
Antimony	NA	NA	NA	D
Arsenic	NA	NA	1.5E+01 (i)	A
Barium	1.4E-04 (h)	NA	NA	D
Beryllium	NA	NA	8.4E+00 (i)	B2
Cadmium	5.7E-05 (x)	NA	6.3E+00 (i)	B1
Chromium	NA	NA	2.9E+02 (i)	A
Cobalt	2.9E-04 (n)	NA	NA	D
Copper	NA	NA	NA	D
Cyanide	8.6E-04 (i)	NA	NA	D
Lead	NA	NA	NA	B2
Mercury	8.6E-05 (i)	8.6E-05 (h)	NA	D
Nickel	NA	NA	8.4E-01 (i)	A
Selenium	NA	NA	NA	D
Silver	NA	NA	NA	D
Thallium	NA	NA	NA	D
Vanadium	NA	NA	NA	D
Zinc	NA	NA	NA	D

e = estimated value based on most toxic non-carcinogenic PAH (pyrene)
i = IRIS, 1997
h = HEAST, 1997
n = provisional value (NCEA, 1996)
r = route to route extrapolation
x = withdrawn value

TABLE 8-14

NON-CARCINOGENIC AND CARCINOGENIC DERMAL HUMAN HEALTH EFFECTS CRITERIA FOR SOIL AND GROUNDWATER COCs
BASF-WYANDOTTE RFI

CONSTITUENT	Chronic Dermal RfD[1] (mg/kg/day)	Subchronic Dermal RfD[2] (mg/kg/day)	Dermal CSF[3] (mg/kg/day)-[1]	Carcinogenic Class
Acetone	8.0E-02	8.0E-01	NA	D
Benzene	1.4E-03	NA	3.6E-02	A
Chlorobenzene	1.6E-02	NA	NA	D
1,2-Dichlorobenzene	7.2E-02	NA	NA	D
1,2-Dichloropropane	8.8E-04	3.0E-03	8.5E-02	B2
Ethylbenzene	8.0E-02	NA	NA	D
Methyl Ethyl Ketone	4.8E-01	1.6E+00	NA	D
Styrene	1.6E-01	NA	NA	D
Toluene	1.6E-01	1.6E+00	NA	D
1,2,3-Trichloropropane	4.8E-03	4.8E-02	8.8E+00	B2
Vinyl Chloride	NA	NA	2.4E+00	A
Xylenes	1.6E+00	NA	NA	D
Acenaphthene	3.0E-02	3.0E-01	NA	D
Acenaphthylene	1.5E-02	1.5E-01	NA	D
Anthracene	1.5E-01	1.5E+00	NA	D
Benzo(a)anthracene	NA	NA	1.5E+00	B2
Benzo(a)pyrene	NA	NA	1.5E+01	B2
Benzo(b)fluoranthene	NA	NA	1.5E+00	B2
Benzo(k)fluoranthene	NA	NA	1.5E-01	B2
Benzo(g,h,i)perylene	1.5E-02	1.5E-01	NA	D
Benzyl alcohol	1.5E-01	5.0E-01	NA	D
bis(2-Chloroethyl) ether	NA	NA	2.2E+00	B2
bis(2-Chloroisopropyl) ether	2.0E-02	2.0E-02	1.4E-01	C
bis(2-Ethylhexyl) phthalate	1.0E-02	NA	2.8E-02	B2
4-Chloro-3-methylphenol	NA	NA	NA	D
2-Chlorophenol	2.5E-03	2.5E-02	NA	D
Chrysene	NA	NA	1.5E-02	B2
Dibenzofuran	2.0E-03	NA	NA	D
Diethyl phthalate	4.0E-01	4.0E+00	NA	D
2,4-Dimethylphenol	1.0E-02	1.0E-01	NA	D
2,4-Dinitrotoluene	1.0E-03	1.0E-03	1.4E+00	B2
Fluoranthene	2.0E-02	2.0E-01	NA	D
Fluorene	2.0E-02	2.0E-01	NA	D
Indeno(1,2,3-cd)pyrene	NA	NA	1.5E+00	B2
2-Methylnaphthalene	1.5E-02	NA	NA	D
2-Methylphenol	2.5E-02	2.5E-01	NA	D

[1] = Chronic Oral RfD multiplied by ingestion absorbtion efficiency (AEi)
[2] = Subchronic Oral RfD multiplied by ingestion absorbtion efficiency (AEi)
[3] = Oral CSF divided by ingestion absorption efficiency (AEi)

TABLE 8-14 (Continued)

NON-CARCINOGENIC AND CARCINOGENIC DERMAL HUMAN HEALTH EFFECTS CRITERIA FOR SOIL AND GROUNDWATER COCs
BASF-WYANDOTTE RFI

CONSTITUENT	Chronic Dermal RfD (mg/kg/day)	Subchronic Dermal RfD (mg/kg/day)	Dermal CSF (mg/kg/day)-1	Carcinogenic Class
3-Methylphenol	2.5E-02	2.5E-01	NA	D
4-Methylphenol	2.5E-03	2.5E-03	NA	D
Naphthalene	2.0E-02	NA	NA	D
4-Nitrophenol	NA	NA	NA	D
N-Nitrosodi-n-propylamine	NA	NA	1.4E+01	B2
Pentachlorophenol	1.5E-02	1.5E-02	2.4E-01	B2
Phenanthrene	1.5E-02	1.5E-01	NA	D
Phenol	3.0E-01	3.0E-01	NA	D
Pyrene	1.5E-02	1.5E-01	NA	D
Pyridine	5.0E-04	5.0E-03	NA	D
o-Toluidine	NA	NA	1.8E+01	B2
1,2,4-Trichlorobenzene	5.0E-03	5.0E-03	NA	D
alpha Chlordane	3.0E-05	3.0E-05	2.6E+00	B2
Arochlor 1248	NA	NA	4.0E+00	B2
Arochlor 1254	1.0E-05	2.5E-05	4.0E+00	B2
Arochlor 1260	NA	NA	4.0E+00	B2
4,4-DDE	NA	NA	6.8E-01	B2
Antimony	8.0E-05	8.0E-05	NA	D
Arsenic	6.0E-05	6.0E-05	7.5E+00	A
Barium	1.4E-02	1.4E-02	NA	D
Beryllium	1.0E-03	1.0E-03	2.2E+01	B2
Cadmium	1.0E-04	NA	NA	B1
Chromium	1.0E-03	4.0E-03	NA	A
Cobalt	1.2E-02	NA	NA	D
Copper	7.4E-03	7.4E-03	NA	D
Cyanide	4.0E-03	4.0E-03	NA	D
Lead	NA	NA	NA	B2
Mercury	6.0E-05	NA	NA	D
Nickel	4.0E-03	4.0E-03	NA	A
Selenium	1.0E-03	1.0E-03	NA	D
Silver	1.0E-03	1.0E-03	NA	D
Thallium	1.6E-05	1.6E-04	NA	D
Vanadium	1.4E-03	1.4E-03	NA	D
Zinc	6.0E-02	6.0E-02	NA	D

[1] = Chronic Oral RfD multiplied by ingestion absorbtion efficiency (AEi)
[2] = Subchronic Oral RfD multiplied by ingestion absorbtion efficiency (AEi)
[3] = Oral CSF divided by ingestion absorption efficiency (AEi)

TABLE 8-15

AVAILABLE WATER QUALITY CRITERIA FOR THE SURFACE WATER COCs
BASF-WYANDOTTE RFI

CONSTITUENT	MICHIGAN SURFACE WATER QUALITY GUIDELINES [1] (mg/L)	USEPA WATER QUALITY STANDARDS (mg/L)	USEPA ECOTOX THRESHOLDS (mg/L)
Benzene	0.053	0.0012	0.045
Chlorobenzene	0.026	0.680	0.130
Vinyl chloride	0.0061	0.002	NA
Acenaphthene	0.0038	NA	0.028
Benzo(a)anthracene	NA	2.8E-06	NA
Benzo(a)pyrene	NA	2.8E-06	0.000014
Benzo(b)fluoranthene	NA	2.8E-06	NA
bis(2-Chloroethyl) ether	0.0059	0.000031	NA
bis(2-Chloroisopropyl) ether	NA	1.4	NA
Chrysene	NA	2.8E-06	NA
2-Methylnaphthalene	NA	NA	NA
4-Methylphenol	0.0062	NA	NA
Naphthalene	0.034	NA	0.024
o-Toluidine	NA	NA	NA
Phenanthrene	NA	NA	0.0063
Pyridine	0.020	NA	NA
Arsenic	0.05	0.000018	0.0081
Barium	0.204 [2]	NA	0.0038
Cadmium	0.000372 [2]	0.0011 [2]	0.001 [2]
Copper	0.0103 [2]	0.012 [2]	0.011 [2]
Cyanide	0.0052	0.0052	0.0052
Lead	0.00228 [2]	0.0032 [2]	0.0025 [2]
Mercury	1.3E-06	0.000012	3.0E-06
Nickel	0.0332 [2]	0.16 [2]	0.16 [2]
Selenium	0.005	0.005	0.005
Vanadium	0.008	NA	0.019
Zinc	0.05 [2]	0.11 [2]	0.10 [2]

[1] Rule 57(2) Guidelines
[2] Hardness dependent criteria (used 100 mg/L $CaCO_3$)

Source: MDNR, 1997
USEPA, 1992
USEPA, 1996

TABLE 8-16

SUMMARY OF PRELIMINARY POTENTIAL HUMAN HEALTH RISKS AT SWMU F
BASF-WYANDOTTE RFI

Exposure Scenario/Pathway	Hazard Index		Cancer Risk Level	
	RAE	RME	RAE	RME
Current Maintenance Workers				
Vapor Inhalation	5E-03	3E-02	1E-07	9E-07
Total	5E-03	3E-02	1E-07	9E-07
Future Maintenance Workers				
Soil Ingestion	1E-03	4E-03	1E-07	3E-07
Soil Dermal Absorption	2E-04	6E-04	2E-08	4E-08
Dust Inhalation	2E-06	8E-06	5E-08	1E-07
Vapor Inhalation	2E-02	1E-01	5E-07	3E-06
Total	2E-02	1E-01	7E-07	3E-06
Future Facility Workers				
Soil Ingestion	1E-02	4E-02	1E-06	3E-06
Soil Dermal Absorption	2E-03	6E-03	2E-07	4E-07
Dust Inhalation	7E-06	3E-05	2E-07	4E-07
Vapor Inhalation	7E-02	4E-01	2E-06	1E-05
Total	8E-02	4E-01	3E-06	1E-05
Future Construction/Utility Workers				
Soil Ingestion	2E-02	8E-02	1E-07	3E-07
Soil Dermal Absorption	3E-04	1E-03	2E-09	4E-09
Dust Inhalation	2E-06	7E-06	2E-09	4E-09
Vapor Inhalation	7E-02	4E-01	2E-07	1E-06
Groundwater Dermal Absorption	8E-03	2E-02	2E-05	2E-05
Total	1E-01	5E-01	2E-05	2E-05

TABLE 8-17

SUMMARY OF PRELIMINARY POTENTIAL HUMAN HEALTH RISKS AT SWMU G
BASF-WYANDOTTE RFI

Exposure Scenario/Pathway	Hazard Index		Cancer Risk Level	
	RAE	RME	RAE	RME
Current Maintenance Workers				
Soil Ingestion	1E-04	3E-04	3E-08	6E-08
Soil Dermal Absorption	2E-05	4E-05	4E-09	1E-08
Dust Inhalation	5E-08	2E-07	7E-10	2E-09
Total	1E-04	3E-04	3E-08	7E-08
Future Maintenance Workers				
Soil Ingestion	4E-04	1E-03	1E-07	2E-07
Soil Dermal Absorption	6E-05	2E-04	2E-08	4E-08
Dust Inhalation	2E-07	8E-07	3E-09	8E-09
Total	5E-04	1E-03	1E-07	2E-07
Future Facility Workers				
Soil Ingestion	4E-03	1E-02	1E-06	2E-06
Soil Dermal Absorption	6E-04	2E-03	2E-07	4E-07
Dust Inhalation	6E-07	3E-06	1E-08	3E-08
Total	5E-03	1E-02	1E-06	2E-06
Future Construction/Utility Workers				
Soil Ingestion	1E-02	3E-02	1E-07	2E-07
Soil Dermal Absorption	2E-04	4E-04	2E-09	4E-09
Dust Inhalation	2E-07	8E-07	1E-10	3E-10
Groundwater Dermal Absorption	8E-03	2E-02	2E-05	2E-05
Total	2E-02	5E-02	2E-05	2E-05

TABLE 8-18

SUMMARY OF PRELIMINARY POTENTIAL HUMAN HEALTH RISKS AT SWMU H
BASF-WYANDOTTE RFI

Exposure Scenario/Pathway	Hazard Index		Cancer Risk Level	
	RAE	RME	RAE	RME
Current Maintenance Workers				
Vapor Inhalation	2E+00	2E+01	7E-05	6E-04
Total	2E+00	2E+01	7E-05	6E-04
Future Maintenance Workers				
Soil Ingestion	9E-02	8E-01	3E-06	2E-05
Soil Dermal Absorption	8E-03	7E-02	3E-07	2E-06
Dust Inhalation	9E-05	9E-04	1E-07	3E-07
Vapor Inhalation	9E+00	9E+01	3E-04	2E-03
Total	9E+00	9E+01	3E-04	2E-03
Future Facility Workers				
Soil Ingestion	9E-01	8E+00	3E-05	2E-04
Soil Dermal Absorption	8E-02	7E-01	3E-06	2E-05
Dust Inhalation	3E-04	3E-03	4E-07	1E-06
Vapor Inhalation	3E+01	3E+02	9E-04	8E-03
Total	3E+01	3E+02	9E-04	8E-03
Future Construction/Utility Workers				
Soil Ingestion	7E-01	6E+00	3E-06	2E-05
Soil Dermal Absorption	6E-03	6E-02	4E-08	2E-07
Dust Inhalation	3E-05	3E-04	4E-09	1E-08
Vapor Inhalation	3E+01	3E+02	1E-04	9E-04
Groundwater Dermal Absorption	8E-03	2E-02	2E-05	2E-05
Total	3E+01	3E+02	1E-04	9E-04

TABLE 8-19

SUMMARY OF PRELIMINARY POTENTIAL HUMAN HEALTH RISKS AT AOC 1
BASF-WYANDOTTE

Exposure Scenario/Pathway	Hazard Index		Cancer Risk Level	
	RAE	RME	RAE	RME
Current Facility Workers				
Vapor Inhalation	2E-02	2E-02	3E-07	3E-07
Total	2E-02	2E-02	3E-07	3E-07
Future Maintenance Workers				
Soil Ingestion	3E-04	4E-04	5E-09	5E-09
Soil Dermal Absorption	3E-06	2E-05	2E-11	2E-11
Dust Inhalation	3E-07	4E-07	6E-12	6E-12
Vapor Inhalation	2E-02	2E-02	3E-07	3E-07
Total	2E-02	2E-02	3E-07	3E-07
Future Facility Workers				
Soil Ingestion	3E-03	4E-03	5E-08	5E-08
Soil Dermal Absorption	3E-05	2E-04	2E-10	2E-10
Dust Inhalation	1E-06	1E-06	2E-11	2E-11
Vapor Inhalation	7E-02	8E-02	1E-06	1E-06
Total	7E-02	8E-02	1E-06	1E-06
Future Construction/Utility Workers				
Soil Ingestion	8E-03	8E-03	5E-09	5E-09
Soil Dermal Absorption	6E-06	3E-05	2E-12	2E-12
Dust Inhalation	3E-07	4E-07	2E-13	2E-13
Vapor Inhalation	5E-01	6E-01	4E-07	4E-07
Groundwater Dermal Absorption	8E-03	2E-02	2E-05	2E-05
Total	5E-01	6E-01	2E-05	2E-05

TABLE 8-20

SUMMARY OF PRELIMINARY POTENTIAL HUMAN HEALTH RISKS AT AOC 2
BASF-WYANDOTTE RFI

Exposure Scenario/Pathway	Hazard Index		Cancer Risk Level	
	RAE	RME	RAE	RME
Future Maintenance Workers				
Soil Ingestion	3E-04	1E-03	4E-08	1E-07
Soil Dermal Absorption	5E-05	1E-04	6E-09	1E-08
Dust Inhalation	7E-07	5E-06	5E-08	2E-07
Total	4E-04	1E-03	1E-07	3E-07
Future Facility Workers				
Soil Ingestion	3E-03	1E-02	4E-07	1E-06
Soil Dermal Absorption	5E-04	1E-03	6E-08	1E-07
Dust Inhalation	3E-06	2E-05	2E-07	7E-07
Total	4E-03	1E-02	7E-07	2E-06
Future Construction/Utility Workers				
Soil Ingestion	8E-03	2E-02	4E-08	1E-07
Soil Dermal Absorption	1E-04	3E-04	7E-10	1E-09
Dust Inhalation	8E-07	5E-06	2E-09	9E-09
Groundwater Dermal Absorption	8E-03	2E-02	2E-05	2E-05
Total	2E-02	4E-02	2E-05	2E-05

TABLE 8-21

SUMMARY OF PRELIMINARY POTENTIAL HUMAN HEALTH RISKS AT AOC 4
BASF-WYANDOTTE RFI

Exposure Scenario/Pathway	Hazard Index		Cancer Risk Level	
	RAE	RME	RAE	RME
Current Facility Workers				
Vapor Inhalation	2E-01	4E-01	4E-06	6E-06
Total	2E-01	4E-01	4E-06	6E-06
Future Maintenance Workers				
Soil Ingestion	4E-02	7E-02	8E-05	1E-04
Soil Dermal Absorption	9E-03	2E-02	2E-05	3E-05
Vapor Inhalation	3E-01	4E-01	4E-06	6E-06
Total	3E-01	5E-01	1E-04	1E-04
Future Facility Workers				
Soil Ingestion	4E-01	7E-01	8E-04	1E-03
Soil Dermal Absorption	9E-02	2E-01	2E-04	3E-04
Vapor Inhalation	9E-01	1E+00	2E-05	2E-05
Total	1E+00	2E+00	1E-03	1E-03
Future Construction/Utility Workers				
Soil Ingestion	7E-01	1E+00	8E-05	2E-04
Soil Dermal Absorption	1E-02	3E-02	2E-06	4E-06
Vapor Inhalation	7E+00	1E+01	5E-06	7E-06
Groundwater Dermal Absorption	8E-03	2E-02	2E-05	2E-05
Total	8E+00	1E+01	1E-04	2E-04

TABLE 8-22

SUMMARY OF PRELIMINARY POTENTIAL HUMAN HEALTH RISKS AT AOC 5
BASF-WYANDOTTE RFI

Exposure Scenario/Pathway	Hazard Index		Cancer Risk Level	
	RAE	RME	RAE	RME
Future Maintenance Workers				
Soil Ingestion	1E-06	2E-06	---	---
Soil Dermal Absorption	3E-07	4E-07	---	---
Dust Inhalation	2E-09	3E-09	---	---
Total	1E-06	2E-06	---	---
Future Facility Workers				
Soil Ingestion	1E-05	2E-05	---	---
Soil Dermal Absorption	3E-06	4E-06	---	---
Dust Inhalation	8E-09	1E-08	---	---
Total	1E-05	2E-05	---	---
Future Construction/Utility Workers				
Soil Ingestion	3E-05	4E-05	---	---
Soil Dermal Absorption	6E-07	9E-07	---	---
Dust Inhalation	2E-09	3E-09	---	---
Groundwater Dermal Absorption	8E-03	2E-02	2E-05	2E-05
Total	8E-03	2E-02	2E-05	2E-05

--- = Not Calculated. No carcinogenic constituents of concern for this area.

TABLE 8-23

SUMMARY OF PRELIMINARY POTENTIAL HUMAN HEALTH RISKS AT AOC 6
BASF-WYANDOTTE RFI

Exposure Scenario/Pathway	Hazard Index		Cancer Risk Level	
	RAE	RME	RAE	RME
Future Maintenance Workers				
Soil Ingestion	3E-04	8E-04	3E-07	1E-06
Soil Dermal Absorption	5E-05	1E-04	6E-08	2E-07
Dust Inhalation	2E-07	8E-07	3E-08	1E-07
Total	4E-04	9E-04	4E-07	1E-06
Future Facility Workers				
Soil Ingestion	3E-03	8E-03	3E-06	1E-05
Soil Dermal Absorption	5E-04	1E-03	6E-07	2E-06
Dust Inhalation	6E-07	3E-06	1E-07	4E-07
Total	4E-03	9E-03	4E-06	1E-05
Future Construction/Utility Workers				
Soil Ingestion	8E-03	2E-02	3E-07	1E-06
Soil Dermal Absorption	1E-04	3E-04	6E-09	2E-08
Dust Inhalation	2E-07	8E-07	1E-09	5E-09
Groundwater Dermal Absorption	8E-03	2E-02	2E-05	2E-05
Total	2E-02	4E-02	2E-05	2E-05

TABLE 8-24

SUMMARY OF PRELIMINARY POTENTIAL HUMAN HEALTH RISKS AT AOC 7
BASF-WYANDOTTE RFI

Exposure Scenario/Pathway	Hazard Index		Cancer Risk Level	
	RAE	RME	RAE	RME
Future Maintenance Workers				
Soil Ingestion	3E-04	5E-04	4E-08	7E-08
Soil Dermal Absorption	4E-05	7E-05	6E-09	1E-08
Dust Inhalation	2E-07	8E-07	3E-08	4E-08
Total	3E-04	6E-04	8E-08	1E-07
Future Facility Workers				
Soil Ingestion	3E-03	5E-03	4E-07	7E-07
Soil Dermal Absorption	4E-04	7E-04	6E-08	1E-07
Dust Inhalation	8E-07	3E-06	1E-07	1E-07
Total	3E-03	6E-03	6E-07	9E-07
Future Construction/Utility Workers				
Soil Ingestion	7E-03	1E-02	4E-08	7E-08
Soil Dermal Absorption	1E-04	2E-04	6E-10	1E-09
Dust Inhalation	2E-07	8E-07	1E-09	2E-09
Groundwater Dermal Absorption	8E-03	2E-02	2E-05	2E-05
Total	2E-02	3E-02	2E-05	2E-05

TABLE 8-25

SUMMARY OF PRELIMINARY POTENTIAL HUMAN HEALTH RISKS AT AOC 8
BASF-WYANDOTTE

Exposure Scenario/Pathway	Hazard Index		Cancer Risk Level	
	RAE	RME	RAE	RME
Current Facility Workers				
Vapor Inhalation	1E-02	2E-02	2E-07	2E-07
Total	1E-02	2E-02	2E-07	2E-07
Future Maintenance Workers				
Soil Ingestion	1E-04	2E-04	2E-09	2E-09
Soil Dermal Absorption	2E-06	2E-05	1E-11	1E-11
Dust Inhalation	1E-07	2E-07	3E-12	3E-12
Vapor Inhalation	1E-02	2E-02	2E-07	2E-07
Total	1E-02	2E-02	2E-07	2E-07
Future Facility Workers				
Soil Ingestion	1E-03	2E-03	2E-08	2E-08
Soil Dermal Absorption	2E-05	2E-04	1E-10	1E-10
Dust Inhalation	5E-07	8E-07	9E-12	9E-12
Vapor Inhalation	4E-02	6E-02	8E-07	8E-07
Total	4E-02	6E-02	8E-07	8E-07
Future Construction/Utility Workers				
Soil Ingestion	4E-03	4E-03	2E-09	2E-09
Soil Dermal Absorption	4E-06	2E-05	1E-12	1E-12
Dust Inhalation	2E-07	2E-07	1E-13	1E-13
Vapor Inhalation	3E-01	4E-01	2E-07	2E-07
Groundwater Dermal Absorption	8E-03	2E-02	2E-05	2E-05
Total	3E-01	4E-01	2E-05	2E-05

TABLE 8-26

SUMMARY OF PRELIMINARY POTENTIAL HUMAN HEALTH RISKS FOR CURRENT MAINTENANCE WORKERS
BASF-WYANDOTTE RFI

Exposure Scenario/Pathway	Hazard Index		Cancer Risk Level	
	RAE	RME	RAE	RME
Current Maintenance Workers				
SWMU F				
Vapor Inhalation	5E-03	3E-02	1E-07	9E-07
Total SWMU F	5E-03	3E-02	1E-07	9E-07
SWMU G				
Soil Ingestion	1E-04	3E-04	3E-08	6E-08
Soil Dermal Absorption	2E-05	4E-05	4E-09	1E-08
Dust Inhalation	5E-08	2E-07	7E-10	2E-09
Total SWMU G	1E-04	3E-04	3E-08	7E-08
SWMU H				
Vapor Inhalation	2E+00	2E+01	7E-05	6E-04
Total SWMU H	2E+00	2E+01	7E-05	6E-04
TOTAL Current Maintenance Workers	2E+00	2E+01	7E-05	6E-04

TABLE 8-27

SUMMARY OF PRELIMINARY POTENTIAL HUMAN HEALTH RISKS FOR FUTURE MAINTENANCE WORKERS
BASF-WYANDOTTE RFI

Exposure Scenario/Pathway	Hazard Index		Cancer Risk Level	
	RAE	RME	RAE	RME
Future Maintenance Workers				
SWMU F				
Soil Ingestion	1E-03	4E-03	1E-07	3E-07
Soil Dermal Absorption	2E-04	6E-04	2E-08	4E-08
Dust Inhalation	2E-06	8E-06	5E-08	1E-07
Vapor Inhalation	2E-02	1E-01	5E-07	3E-06
Total SWMU F	2E-02	1E-01	7E-07	3E-06
SWMU G				
Soil Ingestion	4E-04	1E-03	1E-07	2E-07
Soil Dermal Absorption	6E-05	2E-04	2E-08	4E-08
Dust Inhalation	2E-07	8E-07	3E-09	8E-09
Total SWMU G	5E-04	1E-03	1E-07	2E-07
SWMU H				
Soil Ingestion	9E-02	8E-01	3E-06	2E-05
Soil Dermal Absorption	8E-03	7E-02	3E-07	2E-06
Dust Inhalation	9E-05	9E-04	1E-07	3E-07
Vapor Inhalation	9E+00	9E+01	3E-04	2E-03
Total SWMU H	9E+00	9E+01	3E-04	2E-03
AOC 1				
Soil Ingestion	3E-04	4E-04	5E-09	5E-09
Soil Dermal Absorption	3E-06	2E-05	2E-11	2E-11
Dust Inhalation	3E-07	4E-07	6E-12	6E-12
Vapor Inhalation	2E-02	2E-02	3E-07	3E-07
Total AOC 1	2E-02	2E-02	3E-07	3E-07
AOC 2				
Soil Ingestion	3E-04	1E-03	4E-08	1E-07
Soil Dermal Absorption	5E-05	1E-04	6E-09	1E-08
Dust Inhalation	7E-07	5E-06	5E-08	2E-07
Total AOC 2	4E-04	1E-03	1E-07	3E-07
AOC 4				
Soil Ingestion	4E-02	7E-02	8E-05	1E-04
Soil Dermal Absorption	9E-03	2E-02	2E-05	3E-05
Vapor Inhalation	3E-01	4E-01	4E-06	6E-06
Total AOC 4	3E-01	5E-01	1E-04	1E-04
AOC 5				
Soil Ingestion	1E-06	2E-06	---	---
Soil Dermal Absorption	3E-07	4E-07	---	---
Dust Inhalation	2E-09	3E-09	---	---
Total AOC 5	1E-06	2E-06	0E+00	0E+00
AOC 6				
Soil Ingestion	3E-04	8E-04	3E-07	1E-06
Soil Dermal Absorption	5E-05	1E-04	6E-08	2E-07
Dust Inhalation	2E-07	8E-07	3E-08	1E-07
Total AOC 6	4E-04	9E-04	4E-07	1E-06
AOC 7				
Soil Ingestion	3E-04	5E-04	4E-08	7E-08
Soil Dermal Absorption	4E-05	7E-05	6E-09	1E-08
Dust Inhalation	2E-07	8E-07	3E-08	4E-08
Total AOC 7	3E-04	6E-04	8E-08	1E-07
AOC 8				
Soil Ingestion	1E-04	2E-04	2E-09	2E-09
Soil Dermal Absorption	2E-06	2E-05	1E-11	1E-11
Dust Inhalation	1E-07	1E-07	3E-12	3E-12
Vapor Inhalation	1E-02	2E-02	2E-07	2E-07
Total AOC 8	1E-02	2E-02	2E-07	2E-07
TOTAL Future Maintenance Workers	1E+01	9E+01	4E-04	2E-03

TABLE 8-28

SUMMARY OF PRELIMINARY POTENTIAL HUMAN HEALTH RISKS FOR RECREATIONAL USERS OF THE DETROIT RIVER
BASF-WYANDOTTE RFI

Exposure Scenario/Pathway	Hazard Index		Cancer Risk Level *	
	RAE	RME	RAE	RME
Recreational Users				
Detroit River				
Surface Water Ingestion - Adult	3E-08	6E-08	1E-11	2E-11
- Child	1E-07	3E-07	*	*
Surface Water Dermal Absorption - Adult	4E-08	8E-08	3E-09	3E-09
- Child	6E-08	1E-07	*	*
TOTAL Recreational User - Adult	7E-08	1E-07	3E-09	3E-09
- Child	2E-07	4E-07	*	*

* Lifetime cancer risk estimate. Childhood cancer risks are included in values presented for the adult.

TABLE 8-29

SUMMARY OF PRELIMINARY POTENTIAL ECOLOGICAL RISKS
BASF-WYANDOTTE RFI

Constituent	Ecotoxicity Quotient RAE	Ecotoxicity Quotient RME
Benzene	3E-06	3E-06
Chlorobenzene	1E-08	1E-08
Vinyl Chloride	4E-07	4E-07
Acenaphthene	1E-07	1E-07
Benzo(a)anthracene	7E-04	7E-04
Benzo(a)pyrene	5E-04	5E-04
Benzo(b)fluoranthene	6E-04	6E-04
bis(2-Chloroethyl) ether	7E-05	9E-05
bis(2-Chloroisopropyl) ether	3E-09	3E-09
Chrysene	5E-04	5E-04
2-Methylnaphthalene	0E+00	0E+00
4-Methylphenol	8E-07	1E-06
Naphthalene	9E-08	1E-07
o-Toluidine	0E+00	0E+00
Phenanthrene	7E-08	7E-08
Pyridine	2E-07	2E-07
Arsenic	9E-04	2E-03
Barium	1E-05	2E-05
Cadmium	4E-07	4E-07
Copper	6E-07	7E-07
Cyanide	9E-05	2E-04
Lead	1E-06	1E-06
Mercury	7E-05	7E-05
Nickel	2E-07	3E-07
Selenium	1E-07	1E-07
Vanadium	2E-06	2E-06
Zinc	3E-07	4E-07
Total EQ	3E-03	5E-03

9.0 SUMMARY AND CONCLUSIONS

Based on the results of the Phase I RFI, the following summary and conclusions are provided below.

9.1 Area-Specific Summaries

9.1.1 Summary of RFI Results for SWMU E

Phase I RFI field investigation tasks were conducted at SWMU E to 1) test the Polyols Pond sediments for RCRA hazardous characteristics, and 2) evaluate any potential impacts to groundwater.

Through the utilization of investigative sediment sampling and PID field screening methods, sediment materials at SWMU E were characterized. None of the four sediment samples from SWMU E exhibited any characteristics of a RCRA hazardous waste. As a result, none of the COCs at this unit have been retained for further evaluation at SWMU E.

To assess any potential groundwater impacts from SWMU E, analytical groundwater results were evaluated for the two wells nearest the unit (i.e., RFIMW-1 and RFIMW-13). Because currently available data do not definitively indicate groundwater flow direction in this portion of the Facility, a pattern of radial flow was assumed. Few organic or inorganic constituents were detected above their respective quantitation limits in either RFIMW-1 or RFIMW-13. In fact, only two individual sampling results for two different metals (cadmium and zinc) exceeded PSALs. Based on the above results, SWMU E is not impacting groundwater quality.

9.1.2 Summary of RFI Results for SWMU F

Phase I RFI field investigation tasks were conducted at SWMU F to: 1) characterize the nature of any chemical constituents within the deposited materials, 2) define the horizontal and vertical extent of the area, and 3) evaluate the deposited filter cake materials for spontaneous combustibility.

Through the utilization of investigative soil borings, visual inspection, PID field screening, and iron screening methods, the horizontal and vertical extent of SWMU F (and associated filter cake) was defined. Visual identification procedures were not wholly sufficient to distinguish between filter cake and distillate blow off (DBO) materials. Test kits for the presence of iron were utilized to assist with the identification process. Confirmation of the iron content for DBO-containing materials facilitated the identification of filter cake material when a "negative" iron result was obtained.

Based on these techniques, the horizontal extent of SWMU F was refined to be a smaller area than estimated in pre-investigation reports. The refined horizontal extent of SWMU F is displayed in Figure 7-19. The most significant changes were attributable to perimeter reductions on the east and south sides of this SWMU where filter cake was not encountered along several of the original perimeter locations.

The vertical extent of SWMU F was also confirmed across the area to a maximum depth of approximately 10 ft bls. Typical filter cake intervals were encountered from 0.5 - 4 ft bls. Filter cake materials also tended to be encountered with a greater frequency and thickness within the southeast quadrant of the refined SWMU F boundaries.

PID field screening results indicated that the most impacted intervals corresponded with the interface between the unsaturated and saturated zones. In addition, higher PID readings were noted in the southern portions of SWMU F.

Analytical results indicated that various VOC, SVOC, pesticide/PCB, and inorganic constituents in the ten subsurface samples collected from SWMU F exceeded their respective PSALs. Based on an evaluation of these levels with respect to the results of the preliminary risk assessment, no unacceptable health risks were identified.

Twelve samples from SWMU F were also submitted to the on-site BASF laboratory for evaluation of spontaneous combustibility. All twelve of the samples yielded a positive result for spontaneous combustibility. However, combustion of the filter cake material represents a concern only when the material is present in a dried state (e.g. moisture content of material has been depleted). Therefore, the damp filter cake material is considered to be stable provided that it is maintained in its current state.

Based on the results described above, no further corrective actions are planned for SWMU F.

9.1.3 Summary of RFI Results for SWMU G

Phase I RFI field investigation tasks were conducted at SWMU G to characterize the nature of any potential residual constituents listed in 40 CFR 264 Appendix IX remaining as a result of the debris staged at this unit, and, if present, 2) delineate the extent of contamination.

Analytical results for the ten surface samples collected within SWMU G verified the absence of any VOCs in this unit. Various SVOC, PCB (1), and inorganic constituents exceeded their respective PSALs; these constituents are likely to be associated with the waste materials being evaluated as part of the overlapping AOC 6.

As a result, the following COCs at SWMU G were retained for evaluation in the preliminary risk assessment:

- VOCs: none;
- SVOCs (8): acenaphthene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, chrysene, indeno(1,2,3-c,d)pyrene, pentachlorophenol, and phenanthrene;
- Pesticides/PCBs (1): Aroclor 1260;
- Metals (3): arsenic, lead, and mercury; and,
- Other Inorganics (1): cyanide.

The detected constituents/concentrations for this unit were subsequently evaluated in the preliminary risk assessment. Based on the preliminary risk assessment results, no unacceptable health risks were identified.

Based on the results described above, no further corrective actions are planned for SWMU G.

9.1.4 Summary of RFI Results for SWMU H

Phase I RFI field investigation tasks were conducted at SWMU H to 1) confirm the location of the former containment pond and ditch, 2) characterize the nature of any constituents in soils as a result of any past releases, and 3) identify and qualitatively characterize any potential migration pathways. As previously stated, there is an overlap in the areal extent of SWMU H and AOC 5.

Trench verification borings, Facility drawings, and historical aerial photographs were utilized to confirm the location of the former containment pond and ditch.

While the fill material in SWMU H is heterogenic, several generalizations can be drawn regarding the stratigraphy of this unit. Several feet of material near the ground surface typically consist of sandy gravelly clay. Beneath the surficial clay, a sequence of black slag gravel and coarse-grained sand interbedded with clay-rich layers was often encountered. This sequence is typically saturated and appears to be relatively permeable. FID readings were often noted to increase dramatically in the saturated sediment.

Beneath the gravel sequence, many of the borings failed to recover any material within the spoon. This occurrence is likely due to very high liquid content and low compressive strength of the clay-like material which was noted to cover the outside of the spoons upon recovery. The thickness of the soft clay-like material was variable, possibly indicating that it acts as a channel fill material. Underlying the fill material, occurrences of peat overlying native fine-grained sand were noted. FID readings were often noted to increase with the occurrence of peat, indicating that it may be absorbing volatile organic constituents.

The highest VOC concentrations were detected at soil boring locations SP09A and SP08B along the hydraulically "upstream" portions of the former trench to the west of Wyandotte Road, and SP03A collected along the eastern portion of the unit approximately 100 ft east of the pumphouse. The highest SVOC concentrations were detected at soil boring locations SP09A, SP10A, and SP08B, again along the hydraulically "upstream" portions of the former trench. While soil boring location SP03A exhibited elevated SVOC levels, soil samples for the remaining six transects all exhibited significantly lower SVOC concentrations.

Volatile and semivolatile Tentatively Identified Compounds (TICs) were evaluated for each sample collected from SWMU H. Quanterra analyzed for PDC isomers (i.e., 1,3-PDC and 2,2-PDC) as TICs using 1,2-PDC standards to quantitate any detected peaks. The highest TIC concentrations were detected for soil boring location SPO10A along the hydraulically "upstream" portion of the former trench to the west of Wyandotte Road. Detected VOC TICs included 1.2 ppm of a cyclohexane isomer, 4,200 ppm of an unknown, 8,100 ppm of an unknown alkane, and 52,900 ppm of an unknown hydrocarbon. Detected SVOC TICs included 52.9 ppm of an unknown hydrocarbon (estimated), 8,100 ppm of an unknown alkane, and 4,200 ppm of an unknown.

Analytical results for the ten soil samples collected within SWMU H verified that various VOC, SVOC, pesticide/PCBs, and inorganics in this unit exceeded their respective PSALs. As a result, the following COCs at SWMU H were retained for evaluation in the preliminary risk assessment:

- VOCs (11): acetone, benzene, chlorobenzene, 1,2-dichlorobenzene, 1,2-DCP, ethylbenzene, methyl ethyl ketone, m- and p-xylenes, o-xylene, toluene, and 1,2,3-TCP;
- SVOCs (24): acenaphthene, benzo(a)anthracene, benzo(a)pyrene, benzo(g,h,i)perylene, benzo(b)fluoranthene, benzo(k)fluoranthene, bis(2-chloroethyl)ether, BCIE, bis(2-ethylhexyl) phthalate, 4-chloro-3-methylphenol, 2-chlorophenol, chrysene, 2,4-dimethylphenol, 2,4-dinitrotoluene, fluoranthene, indeno (1,2,3-cd)pyrene, 2-methylnaphthalene, 4-methylphenol, naphthalene, 4-nitrophenol, N-nitrosodi-n-propylamine, pentachlorophenol, phenanthrene, and 1,2,4-trichlorobenzene;
- Pesticides/PCBs (3): alpha-chlordane, Aroclor 1248, and Aroclor 1254;
- Metals (14): antimony, arsenic, beryllium, cadmium, chromium, cobalt, copper, lead, mercury, nickel, selenium, silver, thallium, and vanadium; and,
- Other Inorganics (1): cyanide.

Based on an evaluation of the detected constituent levels with respect to the results of the preliminary risk assessment, potential health risks were identified for numerous exposure scenarios. Furthermore, 1,2-dichloropropane (1,2-DCP) was identified as the primary contributor to potential risk at SWMU H. However, since the high 1,2-DCP concentration potentially obscured the detection of other organic constituents, the 11 VOCs, 24 SVOCs, and 3 pesticide/PCBs identified above have been retained as COCs for further evaluation purposes.

9.1.5 Summary of Results for AOC 1

Field investigation tasks for AOC 1 were performed as part of the Toluene Remediation Investigation Report (TRIP), as opposed to the RFI. However, TRIP results were subsequently incorporated as part of a supplemental preliminary risk assessment as described in Section 8 of this RFI Report.

Analytical results for samples collected during the TRIP indicated the presence of five VOC compounds. As a result, the following COCs at AOC 1 were retained for evaluation in the preliminary risk assessment:

- VOCs (4): benzene, styrene, ethylbenzene, toluene, and xylene.

The detected constituents/concentrations for this area were subsequently evaluated in the preliminary risk assessment. Based on the preliminary risk assessment results, no unacceptable health risks were identified.

9.1.6 Summary of RFI Results for AOC 2

Phase I RFI field investigation tasks were conducted at AOC 2 to 1) assess the horizontal extent of potential coke-related wastes in this AOC, especially along the eastern edge of the area, and 2) evaluated whether COCs from the Old Coke Plant are migrating through the groundwater to portions of the Facility not under hydraulic control by the operating groundwater extraction system.

Through the utilization of historical aerial photographs, investigative soil borings, visual inspection, and FID/PID field screening methods, the horizontal extent of AOC 2 was refined to a larger area than estimated in pre-investigation reports. The refined horizontal extent of AOC 2 is displayed in Figure 7-24.

The most significant changes were attributable to perimeter expansions on the east and west sides of this AOC. Historical aerial photographs were utilized to adjust the placement of perimeter assessment borings, especially along the west side of the area. In addition, visual evidence of coke-related wastes and elevated FID/PID readings were encountered at several of the original perimeter locations. FID/PID field screening results indicated that the most impacted intervals corresponded with the interface between the unsaturated and saturated zones. These findings were utilized to expand and refine the estimated perimeter of this AOC.

Following delineation of the horizontal extent, eight confirmatory soil borings were completed along the refined perimeter of the AOC. FID/PID field screening results from these confirmatory borings did not indicate the presence of any VOCs. One soil sample from each of the eight borings was submitted for chemical analysis to confirm the horizontal delineation process.

Analytical results indicated that various VOC (low level concentrations), SVOC (primarily PAHs), and inorganic constituents in the eight samples collected from AOC 2 exceeded their respective PSALs. Based on an evaluation of the detected constituent levels with respect to the results of the preliminary risk assessment, no unacceptable health risks were identified.

One of the objectives for the investigation of AOC 2 involved the evaluation of whether compounds of concern from the Old Coke Plant are migrating through groundwater to portions of the Facility not under hydraulic control by the groundwater extraction system. Based upon a review of the potentiometric surface maps, groundwater flow direction in the vicinity of AOC 2 is likely toward the east. In addition, Figure 7-15 indicates that extraction wells E14NC and E15NC are providing groundwater capture for this AOC.

Furthermore, analytical results from the two downgradient monitoring wells (RFIMW-15 and RFIMW-16) did not indicate coking-related VOCs or SVOCs at concentrations which would be indicative of impacted groundwater. Many of the constituents that were detected, in fact, were present below the quantitation limit. Thus, it does not appear that coke-related COCs at this AOC are migrating to portions of the Facility not under hydraulic control of the groundwater extraction system.

9.1.7 Summary of RFI Results for AOC 4

Phase I RFI field investigation tasks were conducted at AOC 4 to 1) define the horizontal and vertical extent of any constituent concentrations at this area, and 2) characterize the nature of any constituent concentrations in deposited coal tar materials.

Through the utilization of historical aerial photographs, a geophysical resistivity survey, investigative soil borings, visual inspection, and PID field screening methods, the estimated horizontal and vertical extent of AOC 4 were determined.

The resistivity survey was initially utilized at AOC 4 to determine the vertical extent of tar in this area. Three transects were used in completing the assessment. Resistivity survey results indicated that the tar typically extended from the surface to a depth of 6-8 ft bls. The apparent thickness increased in the central portions of AOC 4 where the maximum depth was estimated at 15 ft bls.

Conclusions from the resistivity survey were utilized to support the initial placement of fifteen (15) perimeter assessment borings along the perimeter of AOC 4. Two of the boring locations required "step-outs" due to the presence of PID/FID/visual tar evidence. At these locations, the impacted boring was plugged and a new boring was advanced at a location approximately 20-40 ft further away from the source area. None of the final perimeter borings exhibited any PID/visual evidence of tar. In this manner, the horizontal extent of AOC 4 was defined with an approximate 50-ft spacing between sampling locations.

Although two step-outs were completed at AOC 4, it is very unlikely that the horizontal extent of the tar pit extends beneath either of the southern or eastern bordering roads. These roads were installed after the tar pit area had been created (based on aerial photographs) and they have not displayed any indications of sinking under heavy vehicle/truck traffic since that time. Both rationale support the conclusion that the tar area does not extend beneath either of the roads to the east or south of AOC 4. The triangular-shaped horizontal extent of AOC 4 is displayed in Figure 7-25.

Based on the approximate boundaries defined by the vertical and horizontal delineation procedures described above, the approximate tar pit volume at AOC 4 is estimated at 3,000 yd^3.

Following delineation of the horizontal extent, two tar characterization samples were collected from the interior of AOC 4. Both tar samples were submitted for chemical analysis to characterize the nature of the waste material.

Analytical results indicated that five VOCs (benzene, styrene, toluene, m-/p-xylene, and o-xylene), nineteen SVOCs (acenaphthylene, anthracene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, chrysene, dibenzofuran, fluoranthene, fluorene, indeno(1,2,3-cd)pyrene, 2-methylnaphthalene, 3-methylphenol, 4-methylphenol, naphthalene, phenanthrene, phenol, and pyrene), four metals (arsenic, lead, selenium, and thallium), and cyanide exceeded their respective PSALs. Based on an evaluation of the detected constituent levels with respect to the results of the preliminary risk assessment, potential health risks were identified for several exposure scenarios.

As a result, one VOC (benzene) and 16 SVOCs (primarily carcinogenic PAHs [acenaphthylene, anthracene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, chrysene, dibenzofuran, fluoranthene, fluorene, indeno(1,2,3-cd)pyrene, 2-methylnaphthalene, naphthalene, phenanthrene, and pyrene]) have been retained as COCs for further evaluation purposes.

9.1.8 Summary of RFI Results for AOC 5

Phase I RFI field investigation tasks were also conducted to characterize the hydrogeological conditions and nature of constituent concentrations in groundwater beneath AOC 5. Since this issue represented one of the most significant aspects of the Phase I RFI, extensive efforts were dedicated to the completion of this task. As a result, the summary of groundwater results for AOC 5 are comprehensively addressed in the Facility-wide summary presented in Section 9.2.

9.1.9 Summary of RFI Results for AOC 6

Phase I RFI field investigation tasks were conducted at AOC 6 to assess the horizontal and vertical extent of potential coal tar-related wastes in this AOC.

Through the utilization of historical aerial photographs, a geophysical conductivity survey, investigative soil borings, visual inspection, and PID field screening methods, the horizontal extent of AOC 6 was refined to a larger area than estimated in pre-investigation reports. The most significant changes were attributable to perimeter expansions on the east and west sides of this AOC. The refined horizontal extent of AOC 6 is displayed in Figure 7-26.

Conclusions drawn from the conductivity survey were utilized to adjust the placement of the initial perimeter assessment borings. PID/visual evidence (or absence) of coal tar-related wastes was then used to direct the placement of subsequent soil borings.

PID field screening results indicated that the most impacted intervals corresponded with materials in the saturated zone (groundwater table typically ranged from 3-6 ft bls at this AOC). These impacts are best addressed as groundwater issues as opposed to source removal concerns. As a result, PID/visual delineation criteria were focused on materials in the unsaturated unit. Using these criteria, one hundred twenty four (124) total borings (including step-ins/outs) were subsequently completed to assess the perimeter of AOC 6.

Following preliminary delineation of the horizontal extent, eight confirmatory soil borings were completed along the refined perimeter of the AOC. One soil sample from each of the eight borings was submitted for chemical analysis to confirm the horizontal extent of AOC 6. None of these samples exhibited any PID/visual evidence of coal tar materials. Based on preliminary laboratory results which indicated slightly elevated SVOC levels for four of the eight samples, four additional step-out samples were nonetheless collected to supplement the horizontal delineation process. Subsequent analytical results indicated the presence of various VOC (low level concentrations), SVOC (primarily PAHs), and inorganic constituents in the eight samples collected along the refined perimeter of AOC 6.

In summary, an extensive number of soil borings were completed to delineate the perimeter of AOC 6. Based on the absence of 1) visual evidence of coal tar materials, 2) detectable PID readings, or 3) significant levels of detectable VOCs for the collected perimeter samples, the detected PAH concentrations are not associated with coal tar materials. Based on this assertion, the horizontal and vertical extent of AOC 6 have been sufficiently delineated.

Analytical results indicated that one VOC (1,2,3-trichloropropane), fourteen SVOCs (acenaphthene, acenaphthylene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(g,h,i)perylene, chrysene, dibenz(a,h)anthracene, fluoranthene, indeno(1,2,3-c,d)pyrene, 2-methylnaphthalene, naphthalene, and phenanthrene), seven metals (arsenic, chromium, copper, lead, mercury, nickel, and zinc), and cyanide exceeded their respective PSALs. The detected constituents/concentrations for this area were subsequently evaluated in the preliminary risk assessment. Based on the preliminary risk assessment results, no unacceptable health risks were identified.

Based on the results described above, no further corrective actions are planned for AOC 6.

9.1.10 Summary of RFI Results for AOC 7

Phase I RFI field investigation tasks were conducted at AOC 7 to: 1) characterize the nature of any constituent concentrations in deposited Prussian Blue materials, 2) estimate the vertical extent of Prussian Blue materials, and 3) define the horizontal extent of potential Prussian Blue materials for each of the three AOC 7 areas.

Trenching activities, visual inspection methods, and soil analyses were initially utilized to estimate the vertical extent of any Prussian Blue materials. Based on visual evidence, Prussian Blue material was generally encountered in thin lenses (typically less than a 4-inch thickness) and at depths of less than 4 ft bls (although pockets were observed for AOC 7B at depths up to 6 ft bls). The thickness and isolated nature of the deposits support the assertion that Prussian Blue was utilized as fill material in selected areas. Analytical results for the vertical delineation borings at AOC 7A indicated detectable cyanide levels for samples acquired from 11 ft bls, e.g. beyond the depth at which visual detection could be established.

Through the utilization of shallow trenching activities, visual inspection methods (observation of distinctive blue color), investigative soil borings, and historical aerial photographs, the horizontal extent of each AOC 7 area was refined. The horizontal extent of each AOC 7 area is displayed in Figures 7-26, 7-27, and 7-28.

Visual screening results from the trenching and soil boring activities were utilized to assess the perimeter of each AOC 7 area. Following preliminary delineation of the horizontal extent, confirmatory soil borings were completed along the refined perimeter of each AOC 7 area. One soil sample from each of the borings was submitted for chemical analysis to confirm the horizontal extent of each area. None of these samples exhibited any visual evidence of Prussian Blue materials.

In summary, an extensive number of delineation trenches and soil borings were completed to delineate the perimeter of each AOC 7 area. Based on the absence of visual evidence of Prussian Blue materials for the collected perimeter samples, the horizontal extent of each AOC 7 area has been confirmed.

Analytical results for the confirmatory samples collected along the perimeter of AOC 7A indicated the presence of various metals and cyanide. Analytical results for the samples collected along the perimeter of AOC 7B and AOC 7C indicated the presence of various metals, however cyanide was not detected at either of these areas.

As a result, the following COCs at AOC 7 (inclusive of AOC 7A, AOC 7B, and AOC 7C) were retained for evaluation in the preliminary risk assessment:

- Metals (7): arsenic, lead, mercury, nickel, silver, and zinc; and,
- Other inorganics: (1): cyanide.

The detected constituents/concentrations for this area were subsequently evaluated in the preliminary risk assessment. Based on the preliminary risk assessment results, no unacceptable health risks were identified.

Based on the results described above, no further corrective actions are planned for AOC 7.

9.1.11 Summary of Results for AOC 8

Field investigation tasks for AOC 8 were performed as part of the Toluene Remediation Investigation Report (TRIP), as opposed to the RFI. However, TRIP results were subsequently incorporated as part of a supplemental preliminary risk assessment as described in Section 8 of this RFI Report.

Analytical results for samples collected during the TRIP indicated the presence of five VOC compounds. As a result, the following COCs at AOC 8 were retained for evaluation in the preliminary risk assessment:

- VOCs (4): benzene, styrene, ethylbenzene, toluene, and xylene.

The detected constituents/concentrations for this area were subsequently evaluated in the preliminary risk assessment. Based on the preliminary risk assessment results, no unacceptable health risks were identified.

9.2 Summary of Facility-Wide Hydrogeological Characterization

Prior to the RFI, considerable work was conducted at the Facility to define the groundwater flow regime. Data were collected, geologic and hydrogeologic interpretations were made, and a groundwater extraction and treatment system was designed and installed. Largely on the basis of the prior hydrogeologic characterization, as well as details on past operations at the Facility, an RFI workplan intended to provide further geologic and hydrogeologic data was designed and implemented. The RFI provided a significant quantity of new information, some of which validated previous conclusions and some of which has resulted in a dramatically enhanced understanding of the presence and flow (or lack thereof) of groundwater at the Facility. In some cases, the additional findings have been inclusive, and as a result, questions remain to be resolved.

Newly-acquired data have reiterated the complexity of geologic and resulting hydrogeologic conditions at the Facility. As discussed in Section 7.0, of particular significance is the identification of two previously unknown features now believed to be exerting a major impact on the presence and flow of groundwater on-site. A laterally extensive Clay and Peat Unit has been identified at multiple sampling locations and appears to be acting as an aquitard, separating overlying fill and a saturated zone from the underlying saturated Native Sand Unit. In addition, the Lacustrine Clay Unit, which serves as a lower confining unit beneath the Facility, forms a clay ridge running north-south in the eastern portion of the Facility between the extraction wells and the shoreline of the Detroit River. This important feature very likely acts not only as an impediment to downward vertical migration, but also to lateral groundwater flow in an easternly direction.

During the Phase I RFI, activities were completed that identified and better defined the conditions described above. Phase I RFI efforts including the performance of numerous field investigations (completion of soil borings, monitoring wells, water level measurements, aquifer tests [slug and pump tests]); and data evaluation tasks (development of cross-sections, mapping of potentiometric surfaces, assimilation of historical and RFI data sets to display/approximate groundwater conditions) were all conducted as part of this Phase I characterization process.

This section summarizes 1) geological/hydrogeological conditions, 2) existing containment features at the Facility, 3) findings derived from the RFI groundwater flow characterization activities, and

4) BASF's present understanding of the hydrogeological system including a preliminary evaluation of the performance of the groundwater extraction system.

9.2.1 Geological System at the Facility

Soil borings completed during the Phase I RFI provide site-specific stratigraphic and hydrogeologic data. Soil boring data confirmed the presence of four stratigraphic units beneath the Facility. As previously described in Section 7.0, these four units are defined in descending order as the 1) Fill Unit, 2) Clay and Peat Unit, 3) Native Sand Unit, and 4) Lacustrine Clay Unit.

Fill Unit

Since the Facility has been occupied, the pre-existing ground surface has been covered with a heterogenic Fill Unit consisting of reworked sediment, construction debris, and other anthropogenic material. The fill material has created considerable lateral variability in permeability and may also act as a hydraulically separate flow unit from the Native Sand Unit at the Facility.

RFI soil boring data indicated that an heterogeneous Fill Unit overlies the native materials at the Facility. Fill material generally consists of a mixture of bi-products from past manufacturing operations, rubble from past Facility demolition activities, and natural native materials. Fill thickness also varied throughout the Facility, but typically ranged from 6-15 feet.

A thick deposit of fill was identified in the eastern portion of the Facility to the northeast of extraction well E13NB. This localized deposit generally coincides with a topographically high area of the Facility. This area of thick DBO deposits (Central Area) effectively enables the Facility to be separated into three general horizontally defined fill areas (i.e., Central Area, South Area, and North Area) in recognition of the hydraulic response of the fill material in each specific area. Such separation was key to designing and implementing the most appropriate pumping test approach for each area.

Clay and Peat Unit

The next recognized sequence at the Facility is a silty, organic-rich clay and interbedded peat sequence (Clay and Peat Unit). Unit thickness generally ranges from 0 - 4 ft across the Facility, although in selected locations it attains a thickness of up to 9 ft. Soil boring data indicated that the thickness of the unit increased along the southeastern boundary of the Facility. This trend corresponds with the occurrence of a thicker underlying sand layer and a pronounced low in the surface of the Lacustrine Clay Unit. However, other areas of increased thickness are not apparently related to the characteristics of the underlying sand unit. Furthermore, the Clay and Peat Unit appears to be absent in some areas of the Facility. Although the thickness of the Clay and Peat Unit is variable, the material properties of the unit appear to remain relatively constant. Discussion of the material properties is provided in Section 7.1.1.2.

Native Sand Unit

Soil boring results identified the presence of a fine-grained, well-sorted, silty sand (Native Sand Unit) beneath the previously defined units. Unit thickness varied throughout the Facility, but typically ranged from 4 ft - 12 ft. The Native Sand Unit is generally thickest to the southeast and through the center portion of the Facility, demonstrating the same north-south linearity that is present on the surface of the underlying clay. Increasing thicknesses of this unit generally correspond with lows on the underlying clay surface. Where the elevation of the clay surface rises sufficiently, the unit thins or pinches out.

The Native Sand Unit appears to be a channel fill deposit of the pre-historic Detroit River. This sand unit is relatively uniform in grain size and sorting, reflecting the load capacity of the moving water from which it was deposited.

Lacustrine Clay Unit

Soil boring results verified the presence of the Lacustrine Clay Unit beneath the Facility. This unit was generally encountered between 20 - 30 ft bls. Based on interpretations of both site-specific RFI boring results and regional geological information, the Lacustrine Clay Unit is expected to be relatively uniform and continuous beneath the Facility and the immediately surrounding area. As such, it serves as an effective lower confining layer beneath the Facility.

Based on interpretations of soil boring logs from the Facility, it appears that the surface of the Lacustrine Clay Unit generally dips toward the east. Cross-sections were prepared which illustrate the presence of a distinct north-south oriented low that is apparent beneath the central and southern portions of the Facility. However, further to the east, a rise in the clay surface elevation effectively creates a "clay ridge" along the shoreline to the Detroit River. The implications of this clay ridge are described below in Section 9.2.2.3.

9.2.2 Existing Containment Features

9.2.2.1 Facility Groundwater Extraction System

In response to a 1986 Consent Decree, BASF installed a groundwater extraction/treatment system at the Facility which continues to be operated in order to prevent the flow of contaminated groundwater (as that term is defined in the Consent Decree) to the Detroit River. From 1987-1996, approximately 25 million gallons of groundwater were recovered through the utilization of this system. Various operation and maintenance activities including water level measurements; well cleaning/maintenance;

installation of replacement extraction wells; and installation of replacement/additional piezometers have been implemented over the past 10 years to optimize the performance of the system.

9.2.2.2 Shoreline Improvements

The eastern Facility boundary has been enhanced with shoreline improvements of various engineering designs and materials. Portions of the RFI data support the concept that these improvements may act as a further impediment to groundwater discharge.

Available information indicates that the improvements along the approximate northern half of the shoreline consist of interlocking steel sheet piling. This steel sheet piling system provides an impediment to groundwater flow along the eastern shoreline. In the vicinity of RFIMW-8, other improvements exist in the form of wooden pilings with a concrete cap. Locations of the constructed impediments to groundwater flow are displayed in Figure 3-2.

The steel sheet pilings located along the northern half of the shoreline are seated in the lower confining layer beneath the Facility. As a result, the steel sheet piling system enhances the beneficial properties of the Lacustrine Clay Unit to mitigate the flow of contaminated groundwater to the river.

9.2.2.3 Flow-Impeding Ridge of Lacustrine Clay Unit

As was discussed in Section 7.1.1.1, a north-south trending channel is apparently incised into the Lacustrine Clay Unit which parallels the current river channel. This fluvial channel creates a natural sump to assist in the retention of constituents which may have been released into the lower portion of the unit.

Furthermore, this fluvial channel effectively creates a localized "high elevation" ridge on the Lacustrine Clay Unit surface parallel to the river and a corresponding thinning in the Native Sand Unit. In some instances, the Native Sand Unit pinches out over the clay high altogether. This high is demonstrated in cross-section D-D' of Figure 7-5. One consequence of this absence or thinning of the Native Sand Unit is a reduction in the transmissivity of the unit for groundwater flowing in an easternly direction. This lateral variance in the Native Sand Unit likely augments the extraction system's capability to prevent the off-site flow of contaminated groundwater within the Native Sand Unit.

9.2.2.4 Vertical Separation Effects of Clay and Peat Unit

Geological cross-sections, low vertical permeability, potentiometric data, and pump test results all support the conclusion that the Clay and Peat Unit serves to vertically separate shallow groundwater into two distinct units.

Present over a significant portion of the Facility, the Clay and Peat Unit enhances the controlling capabilities of the groundwater extraction system and likely augments the beneficial effects of the pinchout of the Native Sand Unit. The low vertical permeability of this Clay and Peat Unit provides a degree of vertical hydraulic separation from the overlying Fill Unit. Cross-sectional data and pumping test results support this conclusion.

Potentiometric data from wells screened above and below the Clay and Peat Unit also indicate the potential presence of a vertical hydraulic differential. Separation of water-bearing units (as a result of a lower permeability unit) can result in distinctly different static water levels between the two units at a given location. For example, water elevations in some of the Papadopulos (P series) wells (e.g. July 1996 static level for P-16-N for example) appear higher than expected when compared to other wells screened in the Native Sand Unit. This result is likely to be associated with the vertical separation effect of the Clay and Peat Unit. Thus, water level data collected during the RFI confirm the presence of a lower permeability confining unit.

In addition, the pumping tests for the extraction wells indicated that the Native Sand Unit in which they are screened acts as a confined or leaky confined water-bearing unit in certain areas. In contrast, however, there are several borings where the Clay and Peat Unit was not encountered. Thus, while the Clay and Peat Unit (e.g. a competent vertical hydraulic flow barrier) appears to have an effect on the extraction system's capability to control groundwater flow in the Fill Unit, its complete impact cannot be defined at this time.

9.2.2.5 Buried Foundations

There appear to be numerous small-scale, and several large-scale, anthropogenic barriers to groundwater flow at the Facility. In the absence of fully penetrating hydraulic barriers, monitoring wells located beneath a cap (e.g. asphalt) would typically respond to a recharge event, although possibly with a dampened or delayed effect. This anticipated effect was observed for monitoring well RFIMW-25 which readily responded to rain events.

However, other groundwater monitoring wells responded very slowly to the recharge associated with rain events at the Facility. Static water levels for RFIMW-26 (which is screened beneath asphalt) remained steady during the baseline monitoring period. These observations suggest that RFIMW-26 is hydraulically isolated from the saturated zone in which the other wells are screened. Based on historical Facility information, one reasonable explanation asserts that RFIMW-26 is located within a buried, yet relatively intact foundation which is keyed into the Lacustrine Clay Unit.

9.2.2.6 Ground Surface Contouring

BASF has maintained a pro-active Facility land management program over the past 17 years to enhance drainage control capabilities. Ground surface contouring measures are routinely implemented as new needs arise. These measures have reduced recharge to the water-bearing units and associated contact with potential constituents of concern. As a net result, the efficiency of the groundwater extraction system has been increased.

9.2.3 Groundwater Flow Characterization

9.2.3.1 Groundwater Potentiometric Surface

As previously described in Section 9.2.2.2, groundwater characteristics at the Facility are probably best defined in terms of two separate hydrogeologic units: 1) a shallow groundwater unit (associated with the anthropogenic Fill Unit); and 2) a deeper groundwater unit (associated with the geological Native Sand Unit). The apparent vertical separation of the two units is created by the flow-impairing properties of the Clay and Peat Unit. In accordance with the specifications of the RFI Workplan and BASF's pre-RFI understanding of the hydrogeological system, the majority of the RFI field tasks, data assessment, and associated findings were focused on the evaluation of the deeper groundwater unit.

Northern and Southeastern Areas
For the northern and southeastern areas of the Facility (refer to Section 7.1.2.3 for area definitions/descriptions), potentiometric data indicate the presence of a low flow gradient toward the Detroit River. However, Papadopulos (1984) indicated that the Detroit River potentially acts to recharge groundwater in the southeast portion of the Facility during concurrently high stages of the river and low stages of the water table. This scenario is most likely to occur during the summer months of June, July, August, and possibly September. Water level measurements acquired for RFIMW-11 and the Detroit River on August 10, 1997 did not substantiate this situation, but rather indicated a very gentle gradient toward the river.

Southwestern Area
Phase I RFI potentiometric data for the southwestern area of the Facility (refer to Section 7.1.2.3 for area definition/description) indicate the presence of a low flow gradient toward the southwest. It is possible that groundwater moving in a southwesterly direction is ultimately captured by the city sewer system. Furthermore, potentiometric data from the RFI indicate the presence of a groundwater divide which separates southwesterly and southeasterly groundwater flow in the southern one-third of the Facility.

Vertical Separation of Groundwater Flow

Due to the presence of an aquitard to vertical flow (Clay and Peat Unit), groundwater flow at the Facility is likely separated into two distinct units. Only the lower of these two units was monitored during the Phase I RFI. The apparent groundwater flow toward the southwest is potentially attributable to vertical hydraulic separation.

9.2.3.2 Water Level Data from Aquifer Tests

Water level data acquired from the pumping test activities were also useful in characterizing groundwater flow at the Facility. As previously described in Section 7.1.2, these data were plotted in Figure 7-11 to illustrate the temporal variation of water levels for monitoring wells RFIMW-6, RFIMW-8, RFIMW-11, RFIMW-18, and RFIMW-20, as well as two monitoring stations installed within the Detroit River (designated River N and River S).

Well-Specific Conclusions

The measured head at monitoring well RFIMW-6 (east central area along the shoreline) was consistent at approximately 3 inches higher than the river measurement (River N). This apparent gradient from RFIMW-6 to the river is greater than the corresponding gradients for either of the other two shoreline wells measured (RFIMW-8 or RFIMW-11). These data support the conclusion that the steel sheet piling system (in the vicinity of RFIMW-6) serves as an impediment to groundwater flow between the Facility and the river. However, the correlation coefficient between the available water level data for RFIMW-6 and the River N monitoring station is 0.49 (a correlation coefficient of 1.0 indicates that one set of data corresponds perfectly with another data set). This relationship is similar to the connection between RFIMW-11 and River S (correlation coefficient of 0.53) where sheet piling is not present.

Data acquired from monitoring well RFIMW-20 (southeast area not immediately along the shoreline) were highly variable. Regular and nearly diurnal cyclic variations of 0.5 ft or less were prominent for the initial approximate 6.2 days (9,000 minutes) of the test. Dampening effects were noted from approximately 6.2 days to 15.3 days (22,000 minutes); more apparent cyclical variations then resumed until approximately 20.1 days (29,000 minutes). Water level changes at RFIMW-20 were noted to occur abruptly, e.g. the rate of change is very rapid creating a series of modified square waves rather than sinusoidal variations. Based on the wave type observed, these findings are not likely to be associated with naturally-occurring phenomena at the Facility. Furthermore, these cyclical variations at RFIMW-20 do not appear to correspond with observed variations for data from RFIMW-11 or the River S monitoring station.

Water level data acquired from monitoring well RFIMW-8 (east central area along the shoreline) were remarkable since they appeared to track incremental changes of the river level (e.g. level changes as small as several tenths of a foot and as short as one hour in duration). The correlation coefficient between the available water level data for RFIMW-8 and the River N monitoring station (test start-up until 24.2 days [34,875 minutes]) is 0.93. This correlation indicates the presence of a strong hydraulic connection between RFIMW-8 and the Detroit River.

Data acquired from RFIMW-18 (east central area not immediately along the shoreline) were unusually stable. This finding may be indicative of a hydraulic barrier in the vicinity of RFIMW-18. However, the stability of the water level data may also be associated with a transducer/cable mechanical failure.

9.2.3.3 Efficiency of Facility Groundwater Extraction System

The efficiency of the groundwater extraction system at the Facility was evaluated using three methods which incorporated data from the Phase I RFI and previous investigations. These methods were utilized to determine whether the system prevents contaminated groundwater at the Facility from discharging off-site. Data evaluations were necessarily focused on the Native Sand Unit since the extraction wells are screened in this unit. The three evaluation methods and associated findings are described below.

Potentiometric Data Evaluation

The first and simplest evaluation method incorporated the potentiometric data acquired from the four quarterly groundwater sampling events. These data were plotted and contoured to facilitate a straightforward determination of groundwater flow direction.

Based on hydraulic potential considerations, each of the developed potentiometric surface maps indicates that a component of groundwater flow is likely discharging to the river. However, the potentiometric contour surfaces do not incorporate data from the extraction system. As a result, quantitative determination of the groundwater discharge cannot be rendered using only this data.

In addition, detailed interior groundwater flow patterns at the Facility cannot be depicted since the potentiometric data exclude the effects of the extraction system. This limitation further prevents the formulation of any absolute conclusions regarding groundwater discharge from the Facility which are based solely on the potentiometric data.

Approximation of Extraction System Effects

The second evaluation method utilized data acquired from the RFI pumping tests in order to incorporate effects of the groundwater extraction system. Empirical drawdown data from several groundwater extraction wells were utilized to simulate a potentiometric surface for the Facility.

At extraction well locations where empirical data were not available, data points were estimated using historical data (e.g. the intake of the drop pipe was assumed to represent the average pumping water level). This combined set of empirical and estimated data were modeled using a geostatistical kriging algorithm to generate a potentiometric surface which incorporates the effects of the groundwater extraction system. The resulting map of approximate potentiometric conditions is provided in Figure 7-15. As part of the geostatistical evaluation, distance drawdown observations from the pumping tests were used to help constrain the kriging algorithm.

Based on a review of this approximate potentiometric surface map, Figure 7-15 indicates that a component of groundwater flow is likely discharging to the river. However, quantitative determination of the groundwater discharge cannot be rendered using these data.

Additionally, the extraction system appears to be most effective in the southern half of the Facility where a majority of the horizontal hydraulic gradients are essentially flat or slightly toward the interior of the Facility. In contrast, horizontal gradients toward the river along the northern portion of the Facility indicate reasonable potential for off-site migration in these areas.

In addition, the presence of a groundwater "divide" (roughly parallel to the river along the eastern side of the Facility) was deduced from a review of Figure 7-15. Although its location cannot be precisely defined at this time, this divide further supports the conclusion that a component of groundwater flow is likely discharging to the river.

Capture Zone Determination

The third evaluation method utilized a simple capture zone model developed by David Keith Todd (*Groundwater and Hydrology*, 1979). This method recognizes that the areal extent of a capture zone for a pumping well is a parabola, the geometry of which is described by the intersection of a cone (extraction well cone of depression) and a plane (the water table). Key method considerations include the assumption of a homogeneous aquifer of practically infinite extent, uniform gradient, and uniform transmissivity.

The geometry of the capture zone is a function of the horizontal gradient, the transmissivity of the saturated interval, and the rate at which each well is pumped. Capture zones developed for the groundwater extraction system at the Facility indicate that most, if not all, of the groundwater flowing onto the Facility from the western boundary would eventually be drawn into the system's radius of influence. The capture zones would also extend downgradient far enough to cover most of the Facility in the downgradient direction.

For the capture zone determinations previously described, the saturated unit at the Facility was assumed to consist of a single unit without any areally extensive barriers to vertical flow. As previously noted in Section 9.2.2.4, there is evidence to suggest that this is not the case. The confining nature of this Clay and Peat Unit provides a degree of vertical hydraulic separation from the overlying Fill Unit. This confining unit is also likely to enhance the efficiency of the groundwater extraction system, although this assertion cannot be verified without additional data.

The most significant limitation of this evaluation method lies in its failure to address meteoric recharge (e.g. rainfall at the Facility). Meteoric recharge to the area reduces the extraction system's area of influence, thus raising the potential for off-site migration of groundwater.

Furthermore, the model assumptions of homogeneity and uniformity are incompatible with actual subsurface conditions at the Facility. As a result, the utilization of any capture zone related findings may be limited in nature.

9.2.4 Summary of Conclusions for Hydrogeological Characterization

Extensive efforts related to characterization of the groundwater flow regime and groundwater quality have been completed at the Facility, both prior to and during the Phase 1 RFI. Previous activities culminated in the design and installation of a groundwater recovery and treatment system, the intent of which was to prevent off-site migration of contaminated groundwater. As described in this report, Phase I RFI activities focused on further geologic and hydrogeologic characterization, as well as the effectiveness of the existing extraction and treatment system in meeting its stated objectives.

As indicated by historical information and QST's recently-completed RFI activities at the Facility, both the Facility geologic and hydrogeologic conditions are quite complex. This situation is due in part to natural and in part to man-made events. The underlying Clay and Peat Unit acts as an apparent aquitard across a significant portion of the Facility. As indicated in numerous boring logs, underlying clay materials beneath the Native Sand Unit effectively form a ridge in the central portion of the Facility and may serve as an impediment to eastward lateral groundwater flow. Furthermore, this ridge likely creates a natural groundwater divide, running north-south through the Facility between existing extraction wells and the shoreline of the Detroit River. Non-native fill materials are quite variable in nature and, depending on the type of material encountered, may act either as an impediment or enhancement to lateral migration. Extensive subsurface foundation materials from past operations remain in place and have been shown to impact flow conditions. Approximately one-half of the Facility is bounded on the east by a metal sheet pile or wooden piling materials. As discussed in Section 7 of this Report, the fifteen extraction wells have removed an average of approximately 2.5 million gallons of groundwater per year over the last 10 years.

Groundwater pumping and surface water elevation measurements provided considerable information on flow dynamics at the Facility. To a large degree, however, they served to underscore data gaps that will be addressed during future Facility activities. In particular, evaluation of data to date suggests that two water-bearing units may be present at the Facility. Previous interpretations (and resulting monitoring studies) did not reach similar conclusions. Although preliminary evaluation of the Phase I RFI data indicates apparent groundwater migration toward the Detroit River for some areas of the Facility, this assertion could not be quantified using the currently available data.

10.0 REFERENCES

The following list includes references cited in the text and general references used in the preparation of the Phase I RFI Report that were not specifically cited in the text.

Beak Consultants Limited. 1991. Environmental Assessment of Detroit River Sediments and Benthic Macroinvertibrate Communities.

Bierschenk, W.H., 1964, Determining Well Efficiency by Multiple Step-Drawdown Tests. Publication 64, International Association of Scientific Hydrology.

Carter, Donna S. and Hites, Ronald A. 1992. Unusual Alkylphenols and Their Transport in the Trenton Channel of the Detroit River, Michigan. School of Public and Environmental Affairs and Department of Chemistry, Indiana University, Bloomington, Indiana.

Comba, Michael E. and Kaiser, Klaus L. E. 1985. Volatile Halocarbons in the Detroit River and Their Relationship with Contaminant Sources. Environmental Contaminants Division, National Water Research Institute, Department of the Environment, Canada Centre for Inland Waters.

Davis, John C., 1973, Statistics and Data Analysis in Geology, John Wiley & Sons, Inc., New York, 550 p.

Department of Natural Resources, 1994, Verification of Soil Remediation , Michigan Department of Natural Resources Environmental Response Division and Waste Management Division.

Department of Natural Resources, 1990, Michigan Environmental Response Act - 1982 Public Act 307, as amended Administrative Rules, Michigan Department of Natural Resources Environmental Response Division.

Detroit River Area of Concern Status Assessment (Draft). May 14, 1997. International Joint Commission.

Detroit River Remedial Action Plan Report, Contaminated Sediments TWG Report (Draft). 1996.

Furlong, Edward T., Carter, Donna S. and Hites, Ronald A. 1988. Organic Contaminants in Sediments from the Trenton Channel of the Detroit River, Michigan. School of Public Affairs and Department of Chemistry, Indiana University, Bloomington, Indiana.

Nichols, S. J., et al. 1991. Heavy Metal Contamination of Sediments in the Upper Connecting Channels of the Great Lakes. National Fisheries Research Center-Great Lakes, U.S. Fish and Wildlife Service.

S.S. Papadopulos & Associates, Inc., 1984, Rate and Direction of Ground-Water Flow at the North Works, BASF Wyandotte Corporation, Wyandotte, Michigan, Volume I Main Report.

S.S. Papadopulos & Associates, Inc., 1985, Preliminary Evaluation of Extraction Well Systems, BASF Wyandotte Corporation North Works, Wyandotte, Michigan.

Papadopulos, I.S. and Cooper, H.H., 1967, Drawdown in a well of large diameter, Water Resources Res., Vol. 3, pp. 241-244.

Results of Trenton Channel Project Sediment Surveys. 1993-1996.

Theis, C.V., 1935, The relation between the lowering of the piezometric surface and the rate and duration of discharge of a well using groundwater storage., Tran. Amer. Geophys. Union, Vol.16, pp.519-524.

Todd, D.K., 1980, Groundwater Hydrology, 2nd ed., New York, John Wiley, pp.121-123.

U.S. Environmental Protection Agency (EPA). 1989. Methods for Evaluating the Attainment of Cleanup Standards. Volume I: Soils and Solid Media. Office of Policy, Planning, and Evaluation, Statistical Policy Branch (PM-223), Washington, DC. EPA/230/02-89-042.

U.S. Environmental Protection Agency (EPA). 1994. Generic Soil Screening Levels for Superfund, Review Draft.

U.S. Environmental Protection Agency (EPA). 1994. Requirements for Quality Assurance Project Plans for Environmental Data Operations. EPA QA/R-5.

U.S. Environmental Protection Agency (EPA), et. al., 1988. Upper Great Lakes Connecting Channels Study, volume II, 626 p.

U.S. Environmental Protection Agency (EPA). 1994. Administrative Consent Order, U.S. EPA Docket No. V-W-011-94.

U.S. Environmental Protection Agency (EPA). 1992. Estimating Potential of Occurrence of DNAPL at Superfund Sites, USEPA Publication 9355.4-07FS, January 1992.

U.S. Environmental Protection Agency (EPA). 1987a, Data Quality Objectives for Remedial Response Activities: Developoment Process, Washington D.C., March 1987, EPA 540/G-87/003.

U.S. Environmental Protection Agency (EPA). 1987b, Data Quality Objectives for Remedial Response Activities: Example Scenario RI/FS Activities at a Site with Contaminated Soils and Ground Water, Washington D.C., March 1987, EPA 540/G-878/004.

U.S. Environmental Protection Agency (EPA). 1986. RCRA Ground-Water Monitoring Technical Enforcement Guidance Document, Washington D.C., September 1986, OSWER-9950.1

APPENDIX A

Excerpts of Geological Data and Analytical Results from Prior Investigations

ENVIRONMENTAL DRILLING AND PID RESULTS
FOUR FOOT (4') TO SIX FOOT (6') BORINGS
NEW RAILYARD EXPANSION AREA
BASF CORPORATION
WYANDOTTE, MICHIGAN

BASF CORPORATION
1609 BIDDLE AVENUE
WYANDOTTE, MICHIGAN 48192

JULY 12, 1996
BY
McDOWELL & ASSOCIATES

McDOWELL & ASSOCIATES
21355 Hatcher Avenue
Ferndale, Michigan 48220

Phone: (810) 399-2066
Fax: (810) 399-2157

July 12, 1996

BASF Corporation
1609 Biddle Avenue
Wyandotte, Michigan 48192

Job No. 96-359

Attention: Dave Sheaves

Subject: Environmental Drilling and PID Results
Four Foot (4') to Six Foot (6') Borings
New Railyard Expansion Area
BASF Corporation
Wyandotte, Michigan

Dear Mr. Sheaves:

As you requested, we made twenty-two (22) Shallow Soil Borings at or near the locations you requested at the subject property. The borings were staked by our drillers for possible future accurate locating by your surveyors. Soil Samples obtained in the borings were screened for the presence of volatile organic compound vapors utilizing an HNu photoionization detector (PID).

Detailed descriptions of subsurface conditions encountered during completion of the soil borings are included in the attached Log of Soil Boring sheets. In general, borings encountered variable and what appeared to be uncontrolled fills to the depths at which borings were completed. Prior to making each boring, the drilling equipment and sampling tools were cleaned using a high pressure hot water washer. Soil samples were collected continuously throughout each of the borings. Samples were recovered using a split spoon sampler in conjunction with standard penetration testing. Upon recovery, each sample was screened in the field for the presence of volatile organic compound vapors using an HNu PID. The PID used a 10.2 eV lamp and was calibrated using an isobutylene reference standard gas. Each sample was placed in a labeled pre-cleaned glass jar and stored in an ice chest until delivery to Mr. David Sheaves of BASF Corporation. Portions of split spoon sample were selected for bottling based on PID screening results, sample appearance, and estimated potential for contamination. Upon completion of each boring, the resultant borehole was backfilled with resultant soil cuttings and bentonite chips to the ground surface.

A summary of PID results is enclosed as Table 1.

If you have any questions or need additional information, please do not hesitate to call.

Very truly yours,

McDOWELL & ASSOCIATES

Douglas M. McDowell
Project Engineer

DMM/dl

Attachments: Table 1 - PID Results
Log of Boring Sheets (22 pages)

Job No. 96-359
July 11, 1996

PID RESULTS

Location Number	Grid Location N/W (1)	Sample Depths Below Grade Level 0' - 2'	2' - 4'	4' - 6'
1	1000/106	ND	ND	ND
2	1050/56	ND	ND	ND
3	1100/88	ND	ND	ND
4	1100/44	ND	ND	
5	1200/70	ND	ND	ND
6	1200/25	ND	ND	
7	1300/30	ND	ND	
8	1400/30	ND	ND	
9	1500/38	ND	ND	ND
10	1600/50	ND	ND	
11	1700/63	ND	ND	ND
12	1800/81	.1	ND	ND
13	1900/131	ND	ND	
14	2000/231	ND	ND	
15	2000/195	ND	ND	
16	2050/225	ND	ND	
17	2050/250	ND	3	
18	2100/275	ND	ND	
19	2100/250	.2	1.2	
20	2150/288	ND	ND	
21	2150/270	ND	1.6	
22	2200/290	ND	.8	

Notes:

1. Grid locations were estimated based upon the location of Monitoring Well E-15 at Grid 1603.66N/87.65W. Actual locations of borings were estimated based upon the location of this well. If exact locations are required, staked boreholes should be surveyed.

2. ND=none detected.

3. HNu results expressed in HNu units (PPM)

LOG OF SOIL BORING NO. 1

McDOWELL & ASSOCIATES
Geotechnical Engineers

PROJECT BASF

JOB NO. 96-359

LOCATION 1609 Biddle Avenue
Wyandotte, Michigan

SURFACE ELEV.

DATE 7-10-96

Sample & Type	Depth	Penetration Blows For 6"	Moisture %	Natural Wt. P.C.F.	Dry Den Wt. P.C.F.	Unc. Comp. Strength PSF.	Str. %
A		5					
SS	1	6					
		29					
	2	24					
B		9					
SS	3	6					
		5					
	4	9					
C		1					
SS	5	2					
		5					
	6	9					
	7						
	8						
	9						
	10						
	11						
	12						
	13						
	14						
	15						
	16						
	17						
	18						
	19						
	20						
	21						
	22						
	23						
	24						
	25						

SOIL DESCRIPTION

Depth	Soil Description
0'2"	Moist brown CRUSHED LIMESTONE, fill
1'0"	Compact moist brown fine to medium SAND
2'0"	Extremely compact moist black fine to medium SAND with broken slab and crushed cinder block, fill
4'0"	Compact moist mixed brown and white clayey fine to medium SAND with glass and occasional gravel seams, fill
5'0"	Slightly compact wet white clayey fine to medium SAND, fill
6'0"	Compact wet brown fine to medium SAND with pebbles and odor, possible fill

TYPE OF SAMPLE
D. - DISTURBED
U.L. - UNDIST. LINER
S.T. - SHELBY TUBE
S.S. - SPLIT SPOON
R.C. - ROCK CORE
( ) - PENETROMETER

REMARKS:

Standard Penetration Test - Driving 2" OD Sampler 1' With 140# Hammer Falling 30"; Count Made At 6" Intervals

GROUND WATER OBSERVATIONS
G.W. ENCOUNTERED AT 4 FT. 0 INS.
G.W. ENCOUNTERED AT FT. INS.
G.W. AFTER COMPLETION 4 FT. 0 INS.
G.W. AFTER HRS. FT. INS.
G.W. VOLUMES heavy

LOG OF SOIL BORING NO. 2

McDOWELL & ASSOCIATES
Geotechnical Engineers

PROJECT BASF

JOB NO. 96-359

LOCATION 1609 Biddle Avenue
Wyandotte, Michigan

SURFACE ELEV.

DATE 7-10-96

Sample & Type	Depth	Legend	SOIL DESCRIPTION	Penetration Blows For 6"	Moisture %	Natural Wt. P.C.F.	Dry Den Wt. P.C.F.	Unc. Comp. Strength PSF.	Str. %
A			0'2" Moist brown CRUSHED	7					
SS	1		LIMESTONE, fill	6					
				4					
	2			3					
B			Compact moist to wet mixed	4					
SS	3		brown and black fine to	2					
			medium SAND, GRAVEL, SLAG	2					
	4		4'0" & CRUSHED LIMESTONE, fill	4					
C				1					
SS	5		Loosely compact wet black	2					
			fine to medium SAND with	½					
	6		6'0" pebbles, fill	½					
	7								
	8								
	9								
	10								
	11								
	12								
	13								
	14								
	15								
	16								
	17								
	18								
	19								
	20								
	21								
	22								
	23								
	24								
	25								

TYPE OF SAMPLE
D. - DISTURBED
U.L. - UNDIST. LINER
S.T. - SHELBY TUBE
S.S. - SPLIT SPOON
R.C. - ROCK CORE
( ) - PENETROMETER

REMARKS:

Standard Penetration Test - Driving 2" OD Sampler 1' With 140# Hammer Falling 30"; Count Made At 6" Intervals

GROUND WATER OBSERVATIONS

G.W. ENCOUNTERED AT		2 FT.		0 INS.	
G.W. ENCOUNTERED AT		FT.		INS.	
G.W. AFTER COMPLETION		2 FT.		0 INS.	
G.W. AFTER	HRS.	FT.		INS.	
G.W. VOLUMES	heavy				

LOG OF SOIL BORING NO. 3

McDOWELL & ASSOCIATES
Geotechnical Engineers

PROJECT BASF

JOB NO. 96-359

LOCATION 1609 Biddle Avenue
Wyandotte, Michigan

SURFACE ELEV.

DATE 7-10-96

Sample & Type	Depth	Legend		Soil Description	Penetration Blows For 6"	Moisture %	Natural Wt. P.C.F.	Dry Den Wt. P.C.F.	Unc. Comp. Strength PSF.	Str. %
A			0'3"	Compact moist dark brown sandy TOPSOIL	6					
SS	1				9					
				Compact moist brown fine to medium SAND with gravel, fill	8					
	2				6					
B					8					
SS	3				9					
			3'4"	Very compact wet dark brown to black SLAG & fine to medium sandy GRAVEL, fill	14					
	4		3'9"		9					
C			4'0"	Very compact wet white fine to medium SAND with pebbles and trace of clay, fill	5					
SS	5				3					
					1					
	6		6'0"	Slightly compact to medium compact wet discolored brown to black fine to medium SAND with pebbles, fill	2					
	7									
	8									
	9									
	10									
	11									
	12									
	13									
	14									
	15									
	16									
	17									
	18									
	19									
	20									
	21									
	22									
	23									
	24									
	25									

TYPE OF SAMPLE
- D. - DISTURBED
- U.L - UNDIST. LINER
- S.T. - SHELBY TUBE
- S.S. - SPLIT SPOON
- R.C. - ROCK CORE
- ( ) - PENETROMETER

REMARKS:

Standard Penetration Test - Driving 2" OD Sampler 1' With 140# Hammer Falling 30"; Count Made At 6" Intervals

GROUND WATER OBSERVATIONS

G.W. ENCOUNTERED AT	3 FT.	4 INS.		
G.W. ENCOUNTERED AT	FT.	INS.		
G.W. AFTER COMPLETION	3 FT.	4 INS.		
G.W. AFTER	HRS.	FT.	INS.	
G.W. VOLUMES	heavy			

LOG OF SOIL BORING NO. 4

McDOWELL & ASSOCIATES
Geotechnical Engineers

JOB NO. 96-359

PROJECT BASF

LOCATION 1609 Biddle Avenue

Wyandotte, Michigan

SURFACE ELEV. ____

DATE 7-10-96

Sample & Type	Depth	Legend		SOIL DESCRIPTION	Penetration Blows For 6"	Moisture %	Natural Wt. P.C.F.	Dry Den Wt. P.C.F.	Unc. Comp. Strength PSF.	Str. %
A			0'6"	Compact moist dark brown sandy TOPSOIL with roots	5					
SS	1				8					
				Very compact moist to wet mixed brown and black fine to medium SAND with some clay and gravel, fill	9					
	2				10					
B			2'6"		10					
SS	3				13					
				Extremely compact wet discolored brown to black fine to medium SAND with trace of pebbles, fill	19					
	4		4'0"		22					
	5									
	6									
	7									
	8									
	9									
	10									
	11									
	12									
	13									
	14									
	15									
	16									
	17									
	18									
	19									
	20									
	21									
	22									
	23									
	24									
	25									

TYPE OF SAMPLE
D. - DISTURBED
U.L. - UNDIST. LINER
S.T. - SHELBY TUBE
S.S. - SPLIT SPOON
R.C. - ROCK CORE
P. - PENETROMETER

REMARKS:

Standard Penetration Test - Driving 2" OD Sampler 1' With 140# Hammer Falling 30"; Count Made At 6" Intervals

GROUND WATER OBSERVATIONS

G.W. ENCOUNTERED AT 2 FT. 0 INS.
G.W. ENCOUNTERED AT FT. INS.
G.W. AFTER COMPLETION dry FT. INS.
G.W. AFTER HRS. FT. INS.
G.W. VOLUMES

LOG OF SOIL BORING NO. 5

McDOWELL & ASSOCIATES
Geotechnical Engineers

PROJECT BASF

JOB NO. 96-359

LOCATION 1609 Biddle Avenue
Wyandotte, Michigan

SURFACE ELEV.

DATE 7-10-96

Sample & Type	Depth	Legend	SOIL DESCRIPTION	Penetration Blows For 6"	Moisture %	Natural Wt. P.C.F.	Dry Den Wt. P.C.F.	Unc. Comp. Strength PSF.	Str. %
A			0'5" ASPHALT	--					
SS	1		Moist mixed brown and dark	4					
			brown fine to medium SAND	5					
	2		2'0" with trace of gravel, fill	5					
B				10					
SS	3		Compact to very compact	12					
			wet brown to black fine	9					
	4		4'0" to medium SAND with pebbles,	6					
C			fill	3					
SS	5		Slightly compact wet black	1					
			fine to medium SAND, fill	1					
	6		6'0"	1					
	7								
	8								
	9								
	10								
	11								
	12								
	13								
	14								
	15								
	16								
	17								
	18								
	19								
	20								
	21								
	22								
	23								
	24								
	25								

TYPE OF SAMPLE
- D. - DISTURBED
- U.L. - UNDIST. LINER
- S.T. - SHELBY TUBE
- S.S. - SPLIT SPOON
- R.C. - ROCK CORE
- ( ) - PENETROMETER

REMARKS:

Standard Penetration Test - Driving 2" OD Sampler 1' With 140# Hammer Falling 30"; Count Made At 6" Intervals

GROUND WATER OBSERVATIONS

G.W. ENCOUNTERED AT		2 FT.		0 INS.	
G.W. ENCOUNTERED AT		FT.		INS.	
G.W. AFTER COMPLETION		2 FT.		0 INS.	
G.W. AFTER	HRS.	FT.		INS.	
G.W. VOLUMES					

LOG OF SOIL BORING NO. 6

McDOWELL & ASSOCIATES
Geotechnical Engineers

PROJECT BASF

JOB NO. 96-359

LOCATION 1609 Biddle Avenue
Wyandotte, Michigan

SURFACE ELEV. ______ DATE 7-10-96

Sample & Type	Depth	Legend	Soil Description	Penetration Blows For 6"	Moisture %	Natural Wt. P.C.F.	Dry Den Wt. P.C.F.	Unc. Comp. Strength PSF.	Str. %
A		0'6"	Compact moist to wet brown CRUSHED LIMESTONE, fill	4					
SS	1	1'0"	Compact moist black SLAG & fine to medium SAND, fill	7					
				21					
	2	2'0"	Extremely compact moist white fine SAND with gravel and trace of clay, fill	21					
B				13					
SS	3			9					
				7					
	4	4'0"	Compact to very compact moist to wet mixed white and brown fine to medium SAND with trace of pebbles and clay and odor, fill	8					
	5								
	6								
	7								
	8								
	9								
	10								
	11								
	12								
	13								
	14								
	15								
	16								
	17								
	18								
	19								
	20								
	21								
	22								
	23								
	24								
	25								

TYPE OF SAMPLE
D. - DISTURBED
U.L. - UNDIST. LINER
S.T. - SHELBY TUBE
S.S. - SPLIT SPOON
R.C. - ROCK CORE
( ) - PENETROMETER

REMARKS:

Standard Penetration Test - Driving 2" OD Sampler 1' With 140# Hammer Falling 30"; Count Made At 6" Intervals

GROUND WATER OBSERVATIONS

G.W. ENCOUNTERED AT		0	FT.	3	INS.
G.W. ENCOUNTERED AT		2	FT.	9	INS.
G.W. AFTER COMPLETION		2	FT.	9	INS.
G.W. AFTER	HRS.		FT.		INS.
G.W. VOLUMES					

LOG OF SOIL BORING NO. 7

McDOWELL & ASSOCIATES
Geotechnical Engineers

PROJECT BASF

JOB NO. 96-359

LOCATION 1609 Biddle Avenue
Wyandotte, Michigan

SURFACE ELEV.

DATE 7-10-96

Sample & Type	Depth	Legend		SOIL DESCRIPTION	Penetration Blows For 6"	Moisture %	Natural Wt. P.C.F.	Dry Den Wt. P.C.F.	Unc. Comp. Strength PSF.	Str. %
A SS	1		1'0"	Soft to firm moist brown sandy CLAY with pebbles	1, 1					
	2		2'0"	Medium compact moist brown fine SAND with pebbles and wood chips, fill	2, 4					
B SS	3			Compact moist multi-color (yellow, gray, rose and white) SAND & GRAVEL with bricks, slag and odor, fill	8, 8					
	4		4'0"		6, 7					
	5									
	6									
	7									
	8									
	9									
	10									
	11									
	12									
	13									
	14									
	15									
	16									
	17									
	18									
	19									
	20									
	21									
	22									
	23									
	24									
	25									

TYPE OF SAMPLE
D. - DISTURBED
U.L. - UNDIST. LINER
S.T. - SHELBY TUBE
S.S. - SPLIT SPOON
R.C. - ROCK CORE
( ) - PENETROMETER

REMARKS:

Standard Penetration Test - Driving 2" OD Sampler 1' With 140# Hammer Falling 30"; Count Made At 6" Intervals

GROUND WATER OBSERVATIONS

G.W. ENCOUNTERED AT none FT. INS.
G.W. ENCOUNTERED AT FT. INS.
G.W. AFTER COMPLETION FT. INS.
G.W. AFTER HRS. FT. INS.
G.W. VOLUMES

LOG OF SOIL BORING NO. 8

McDOWELL & ASSOCIATES
Geotechnical Engineers

PROJECT BASF

JOB NO. 96-359

LOCATION 1609 Biddle Avenue

SURFACE ELEV.

DATE 7-10-96

Wyandotte, Michigan

Sample & Type	Depth	Legend	SOIL DESCRIPTION	Penetration Blows For 6"	Moisture %	Natural Wt. P.C.F.	Dry Den Wt. P.C.F.	Unc. Comp. Strength PSF.	Str. %
A			0'6" Compact moist dark brown sandy TOPSOIL	2					
SS	1		1'2" Stiff moist brown sandy CLAY with pebbles, fill	5					
				5					
	2			6					
B			2'3" Compact moist brown fine SAND, fill	2					
SS	3			1					
				1					
	4		4'0" Slightly compact wet dark brown to black fine SAND with trace of pebbles and gravel, fill	4					
	5								
	6								
	7								
	8								
	9								
	10								
	11								
	12								
	13								
	14								
	15								
	16								
	17								
	18								
	19								
	20								
	21								
	22								
	23								
	24								
	25								

TYPE OF SAMPLE
D. - DISTURBED
U.L. - UNDIST. LINER
S.T. - SHELBY TUBE
S.S. - SPLIT SPOON
R.C. - ROCK CORE
( ) - PENETROMETER

REMARKS:

Standard Penetration Test - Driving 2" OD Sampler 1' With 140# Hammer Falling 30"; Count Made At 6" Intervals

GROUND WATER OBSERVATIONS

G.W. ENCOUNTERED AT 2 FT. 3 INS.
G.W. ENCOUNTERED AT FT. INS.
G.W. AFTER COMPLETION 2 FT. 3 INS.
G.W. AFTER HRS. FT. INS.
G.W. VOLUMES heavy

LOG OF SOIL BORING NO. 9

McDOWELL & ASSOCIATES
Geotechnical Engineers

PROJECT BASF

JOB NO. 96-359

LOCATION 1609 Biddle Avenue

SURFACE ELEV.

DATE 7-10-96

Wyandotte, Michigan

Sample & Type	Depth	Legend		SOIL DESCRIPTION	Penetration Blows For 6"	Moisture %	Natural Wt. P.C.F.	Dry Den Wt. P.C.F.	Unc. Comp. Strength PSF.	Str. %
A					4					
SS	1			Compact to very compact moist brown to dark brown fine to medium SAND with gravel and crushed limestone, fill	6					
					9					
	2				10					
B					10					
SS	3				11					
					11					
	4		4'0"		5					
C				Extremely compact wet red BRICKS with sand and gravel, fill	11					
SS	5		5'0"		34					
				Very compact to compact wet black SLAG with sand and gravel, fill	6					
	6		5'10" 6'0"	Compact wet greenish-brown fine SAND, fill	5					
	7									
	8									
	9									
	10									
	11									
	12									
	13									
	14									
	15									
	16									
	17									
	18									
	19									
	20									
	21									
	22									
	23									
	24									
	25									

TYPE OF SAMPLE
D. - DISTURBED
U.L. - UNDIST. LINER
S.T. - SHELBY TUBE
S.S. - SPLIT SPOON
R.C. - ROCK CORE
( ) - PENETROMETER

REMARKS:

Standard Penetration Test - Driving 2" OD Sampler 1' With 140# Hammer Falling 30"; Count Made At 6" Intervals

GROUND WATER OBSERVATIONS

G.W. ENCOUNTERED AT 4 FT. 0 INS.
G.W. ENCOUNTERED AT FT. INS.
G.W. AFTER COMPLETION 4 FT. 0 INS.
G.W. AFTER HRS. FT. INS.
G.W. VOLUMES heavy

LOG OF SOIL BORING NO. 10

McDOWELL & ASSOCIATES
Geotechnical Engineers

PROJECT BASF

JOB NO. 96-359

LOCATION 1609 Biddle Avenue

SURFACE ELEV. ____ DATE 7-10-96 Wyandotte, Michigan

Sample & Type	Depth	Legend	SOIL DESCRIPTION	Penetration Blows For 6"	Moisture %	Natural Wt. P.C.F.	Dry Den Wt. P.C.F.	Unc. Comp. Strength PSF.	Str. %
A			0'8" Compact moist to wet dark brown CRUSHED LIMESTONE & GRAVEL, fill	2					
SS	1			8					
				9					
	2			5					
B			Compact moist brown fine SAND with gravel and wet crushed limestone and gravel seams, (possible brite sorb), fill	4					
SS	3			7					
			3'9"	3					
	4		4'0" Very compact wet black SLAG with fine to medium sand, pebbles, oil and odor, fill	10					
	5								
	6								
	7								
	8								
	9								
	10								
	11								
	12								
	13								
	14								
	15								
	16								
	17								
	18								
	19								
	20								
	21								
	22								
	23								
	24								
	25								

TYPE OF SAMPLE
D. - DISTURBED
U.L. - UNDIST. LINER
S.T. - SHELBY TUBE
S.S. - SPLIT SPOON
R.C. - ROCK CORE
( ) - PENETROMETER

REMARKS:

Standard Penetration Test - Driving 2" OD Sampler 1' With 140# Hammer Falling 30"; Count Made At 6" Intervals

GROUND WATER OBSERVATIONS

G.W. ENCOUNTERED AT 0 FT. 6 INS.
G.W. ENCOUNTERED AT 3 FT. 0 INS.
G.W. AFTER COMPLETION 3 FT. 0 INS.
G.W. AFTER HRS. FT. INS.
G.W. VOLUMES heavy

LOG OF SOIL BORING NO. 11

McDOWELL & ASSOCIATES
Geotechnical Engineers

PROJECT BASF

JOB NO. 96-359

LOCATION 1609 Biddle Avenue
Wyandotte, Michigan

SURFACE ELEV.

DATE 7-10-96

Sample & Type	Depth	Legend	SOIL DESCRIPTION	Penetration Blows For 6"	Moisture %	Natural Wt. P.C.F.	Dry Den Wt. P.C.F.	Unc. Comp. Strength PSF.	Str. %
A			Slightly compact moist brown CRUSHED LIMESTONE, fill	3					
SS	1			2					
				2					
	2	2'0"		6					
B			Compact to extremely compact moist gray CRUSHED LIMESTONE screenings with fine gravel, fill	6					
SS	3			15					
				19					
	4	4'0"		15					
C			Compact to extremely compact wet gray SAND, CRUSHED LIMESTONE & GRAVEL (possible brite sorb), fill	5					
SS	5	5'0"		35					
				32					
	6	6'0"	Extremely compact wet black SLAG & fine to medium SAND with gravel and some coal, fill	10					
	7								
	8								
	9								
	10								
	11								
	12								
	13								
	14								
	15								
	16								
	17								
	18								
	19								
	20								
	21								
	22								
	23								
	24								
	25								

TYPE OF SAMPLE
- D. - DISTURBED
- U.L. - UNDIST. LINER
- S.T. - SHELBY TUBE
- S.S. - SPLIT SPOON
- R.C. - ROCK CORE
- ( ) - PENETROMETER

REMARKS:

Standard Penetration Test - Driving 2" OD Sampler 1' With 140# Hammer Falling 30"; Count Made At 6" Intervals

GROUND WATER OBSERVATIONS

G.W. ENCOUNTERED AT 4 FT. 0 INS.
G.W. ENCOUNTERED AT FT. INS.
G.W. AFTER COMPLETION 4 FT. 0 INS.
G.W. AFTER HRS. FT. INS.
G.W. VOLUMES medium

LOG OF SOIL BORING NO. 12

McDOWELL & ASSOCIATES
Geotechnical Engineers

PROJECT BASF

JOB NO. 96-359 LOCATION 1609 Biddle Avenue

SURFACE ELEV. ______ DATE 7-10-96 Wyandotte, Michigan

Sample & Type	Depth	Legend		Soil Description	Penetration Blows For 6"	Moisture %	Natural Wt. P.C.F.	Dry Den Wt. P.C.F.	Unc. Comp. Strength PSF	Str. %
A				Medium compact moist brown fine to medium SAND with gravel	3					
SS	1		1'0"		3					
					15					
	2				14					
B					10					
SS	3			Extremely compact moist to wet brown CRUSHED LIMESTONE with fine to medium sand, fill	18					
					39					
	4				12					
C					26					
SS	5		5'0"	Compact wet black sandy TOPSOIL with roots, fill	16					
			5'4"		6					
	6		6'0"	Compact wet multi-color (gray and yellow) fine SAND with pebbles and clay, (possible brite sorb), fill	5					
	7									
	8									
	9									
	10									
	11									
	12									
	13									
	14									
	15									
	16									
	17									
	18									
	19									
	20									
	21									
	22									
	23									
	24									
	25									

TYPE OF SAMPLE
- D. - DISTURBED
- U.L - UNDIST. LINER
- S.T. - SHELBY TUBE
- S.S. - SPLIT SPOON
- R.C. - ROCK CORE
- ( ) - PENETROMETER

REMARKS:

Standard Penetration Test - Driving 2" OD Sampler 1' With 140# Hammer Falling 30"; Count Made At 6" Intervals

GROUND WATER OBSERVATIONS

G.W. ENCOUNTERED AT		4	FT.	0	INS.
G.W. ENCOUNTERED AT			FT.		INS.
G.W. AFTER COMPLETION		4	FT.	0	INS.
G.W. AFTER	HRS.		FT.		INS.
G.W. VOLUMES	heavy				

LOG OF SOIL BORING NO. 13

McDOWELL & ASSOCIATES
Geotechnical Engineers

PROJECT BASF

JOB NO. 96-359

LOCATION 1609 Biddle Avenue
Wyandotte, Michigan

SURFACE ELEV.

DATE 7-10-96

Sample & Type	Depth	Legend	Soil Description	Penetration Blows For 6"	Moisture %	Natural Wt. P.C.F.	Dry Den Wt. P.C.F.	Unc. Comp. Strength PSF.	Str. %
A SS	1		Compact to very compact moist brown fine SAND with gravel and some cobbles, fill	6					
				8					
				13					
	2		2'0"	20					
B SS	3		Very compact moist to wet gray CRUSHED LIMESTONE with fine to medium sand, fill	10					
				9					
				8					
	4		4'0"	6					
	5								
	6								
	7								
	8								
	9								
	10								
	11								
	12								
	13								
	14								
	15								
	16								
	17								
	18								
	19								
	20								
	21								
	22								
	23								
	24								
	25								

TYPE OF SAMPLE
D. - DISTURBED
U.L. - UNDIST. LINER
S.T. - SHELBY TUBE
S.S. - SPLIT SPOON
R.C. - ROCK CORE
( ) - PENETROMETER

REMARKS:

Standard Penetration Test - Driving 2" OD Sampler 1' With 140# Hammer Falling 30"; Count Made At 6" Intervals

GROUND WATER OBSERVATIONS

G.W. ENCOUNTERED AT 3 FT. 0 INS.
G.W. ENCOUNTERED AT FT. INS.
G.W. AFTER COMPLETION 3 FT. 0 INS.
G.W. AFTER HRS. FT. INS.
G.W. VOLUMES heavy

LOG OF SOIL BORING NO. 14

MA

McDOWELL & ASSOCIATES
Geotechnical Engineers

JOB NO. 96-359

PROJECT BASF

LOCATION 1609 Biddle Avenue

Wyandotte, Michigan

SURFACE ELEV. ____ DATE 7-10-96

Sample & Type	Depth	Legend	SOIL DESCRIPTION	Penetration Blows For 6"	Moisture %	Natural Wt. P.C.F.	Dry Den Wt. P.C.F.	Unc. Comp. Strength PSF.	Str. %
A		0'2"	Moist brown GRAVEL, fill	7					
SS	1		Compact moist discolored brown silty fine SAND with trace of pebbles and clay, fill	3					
				4					
	2	2'0"		5					
B				3					
SS	3		Compact to very compact moist to wet gray SAND with clay and pebbles (possible brite sorb), fill	4					
				7					
	4	4'0"		14					
	5								
	6								
	7								
	8								
	9								
	10								
	11								
	12								
	13								
	14								
	15								
	16								
	17								
	18								
	19								
	20								
	21								
	22								
	23								
	24								
	25								

TYPE OF SAMPLE
D. - DISTURBED
U.L. - UNDIST. LINER
S.T. - SHELBY TUBE
S.S. - SPLIT SPOON
R.C. - ROCK CORE
( ) - PENETROMETER

REMARKS:

Standard Penetration Test - Driving 2" OD Sampler 1' With 140# Hammer Falling 30"; Count Made At 6" Intervals

GROUND WATER OBSERVATIONS

G.W. ENCOUNTERED AT 1 FT. 4 INS.
G.W. ENCOUNTERED AT FT. INS.
G.W. AFTER COMPLETION dry FT. INS.
G.W. AFTER HRS. FT. INS.
G.W. VOLUMES light

LOG OF SOIL BORING NO. 15

McDOWELL & ASSOCIATES
Geotechnical Engineers

PROJECT BASF

JOB NO. 96-359

LOCATION 1609 Biddle Avenue

SURFACE ELEV.

DATE 7-10-96

Wyandotte, Michigan

Sample & Type	Depth	Legend	SOIL DESCRIPTION	Penetration Blows For 6"	Moisture %	Natural Wt. P.C.F.	Dry Den Wt. P.C.F.	Unc. Comp. Strength PSF.	Str. %
A			Very compact moist brown fine to medium SAND with crushed limestone, fill	12					
SS	1			6					
		1'6"		8					
	2		Very compact wet brown fine to medium SAND with gravel, fill	11					
B		2'6"		15					
SS	3			10					
			Very compact moist white to gray clayey SAND with crushed limestone and gravel seams (possible brite sorb), fill	9					
	4	4'0"		11					
	5								
	6								
	7								
	8								
	9								
	10								
	11								
	12								
	13								
	14								
	15								
	16								
	17								
	18								
	19								
	20								
	21								
	22								
	23								
	24								
	25								

TYPE OF SAMPLE
D. - DISTURBED
U.L. - UNDIST. LINER
S.T. - SHELBY TUBE
S.S. - SPLIT SPOON
R.C. - ROCK CORE
( ) - PENETROMETER

REMARKS:

Standard Penetration Test - Driving 2" OD Sampler 1' With 140# Hammer Falling 30"; Count Made At 6" Intervals

GROUND WATER OBSERVATIONS

G.W. ENCOUNTERED AT 1 FT. 6 INS.
G.W. ENCOUNTERED AT FT. INS.
G.W. AFTER COMPLETION dry FT. INS.
G.W. AFTER HRS. FT. INS.
G.W. VOLUMES light

LOG OF SOIL BORING NO. 16

McDOWELL & ASSOCIATES
Geotechnical Engineers

PROJECT BASF

JOB NO. 96-359

LOCATION 1609 Biddle Avenue

SURFACE ELEV.

DATE 7-10-96

Wyandotte, Michigan

Sample & Type	Depth	Legend	Soil Description	Penetration Blows For 6"	Moisture %	Natural Wt. P.C.F.	Dry Den Wt. P.C.F.	Unc. Comp. Strength PSF.	Str. %
A			0'2" Moist brown GRAVEL, fill	5					
SS	1		0'7" Stiff moist brown sandy CLAY with gravel, fill	5					
				6					
	2		Compact moist whit to gray clayey SAND with sand and pebbles and some gravel (possible brite sorb), fill	4					
B			2'6"	8					
SS	3			24					
				13					
	4		4'0" Extremely compact moist mixed brown, gray and black silty fine SAND with pebbles and some clay, fill	10					
	5								
	6								
	7								
	8								
	9								
	10								
	11								
	12								
	13								
	14								
	15								
	16								
	17								
	18								
	19								
	20								
	21								
	22								
	23								
	24								
	25								

TYPE OF SAMPLE
- D. - DISTURBED
- U.L - UNDIST. LINER
- S.T. - SHELBY TUBE
- S.S. - SPLIT SPOON
- R.C. - ROCK CORE
- ( ) - PENETROMETER

REMARKS:

Standard Penetration Test - Driving 2" OD Sampler 1' With 140# Hammer Falling 30"; Count Made At 6" Intervals

GROUND WATER OBSERVATIONS

G.W. ENCOUNTERED AT FT. INS.
G.W. ENCOUNTERED AT FT. INS.
G.W. AFTER COMPLETION none FT. INS.
G.W. AFTER HRS. FT. INS.
G.W. VOLUMES

LOG OF SOIL BORING NO. 17

McDOWELL & ASSOCIATES
Geotechnical Engineers

PROJECT BASF

JOB NO. 96-359

LOCATION 1609 Biddle Avenue
Wyandotte, Michigan

SURFACE ELEV.

DATE 7-10-96

SOIL DESCRIPTION

- 0'2" — Moist brown GRAVEL, fill
- 0'6" — Medium compact moist dark brown silty fine SAND with trace of gravel, fill
- 1'4" — Medium compact moist dark brown silty fine to medium SAND with pebbles and some some slag, fill
- 2'0" — Medium compact moist gray to white clayey SAND with gravel and pebbles (possible brite sorb), fill
- 4'0" — Extremely compact moist gray clayey SAND with gravel and pebbles (possible brite sorb), fill

Sample & Type	Depth	Penetration Blows For 6"	Moisture %.	Natural Wt. P.C.F.	Dry Den Wt. P.C.F.	Unc. Comp. Strength PSF.	Str. %
A		5					
SS	1	3					
		3					
	2	2					
B		10					
SS	3	11					
		20					
	4	22					
	5						
	6						
	7						
	8						
	9						
	10						
	11						
	12						
	13						
	14						
	15						
	16						
	17						
	18						
	19						
	20						
	21						
	22						
	23						
	24						
	25						

TYPE OF SAMPLE
D. - DISTURBED
U.L. - UNDIST. LINER
S.T. - SHELBY TUBE
S.S. - SPLIT SPOON
R.C. - ROCK CORE
( ) - PENETROMETER

REMARKS:

Standard Penetration Test - Driving 2" OD Sampler 1' With 140# Hammer Falling 30"; Count Made At 6" Intervals

GROUND WATER OBSERVATIONS
G.W. ENCOUNTERED AT FT. INS.
G.W. ENCOUNTERED AT FT. INS.
G.W. AFTER COMPLETION none FT. INS.
G.W. AFTER HRS. FT. INS.
G.W. VOLUMES

LOG OF SOIL BORING NO. 18

McDOWELL & ASSOCIATES
Geotechnical Engineers

PROJECT BASF

JOB NO. 96-359

LOCATION 1609 Biddle Avenue

SURFACE ELEV. ______ DATE 7-10-96 Wyandotte, Michigan

Sample & Type	Depth	Legend		SOIL DESCRIPTION	Penetration Blows For 6"	Moisture %	Natural Wt. P.C.F.	Dry Den Wt. P.C.F.	Unc. Comp. Strength PSF.	Str. %
A			0'2"	Moist brown GRAVEL	3					
SS	1			Medium compact to compact moist mixed dark brown and black silty fine SAND with pebbles, trace of clay and gravel, fill	4					
			1'6"		6					
	2				17					
B					50					
SS	3		3'0"		50					
	4			Extremely compact moist gray fine silty SAND with gravel and occasional pink layers, fill						
	5									
	6									
	7									
	8									
	9									
	10									
	11									
	12									
	13									
	14									
	15									
	16									
	17									
	18									
	19									
	20									
	21									
	22									
	23									
	24									
	25									

TYPE OF SAMPLE
D. - DISTURBED
U.L. - UNDIST. LINER
S.T. - SHELBY TUBE
S.S. - SPLIT SPOON
R.C. - ROCK CORE
( ) - PENETROMETER

REMARKS:

Standard Penetration Test - Driving 2" OD Sampler 1' With 140# Hammer Falling 30"; Count Made At 6" Intervals

GROUND WATER OBSERVATIONS

G.W. ENCOUNTERED AT FT. INS.
G.W. ENCOUNTERED AT FT. INS.
G.W. AFTER COMPLETION none FT. INS.
G.W. AFTER HRS. FT. INS.
G.W. VOLUMES

LOG OF SOIL BORING NO. 19

McDOWELL & ASSOCIATES
Geotechnical Engineers

PROJECT BASF

JOB NO. 96-359

LOCATION 1609 Biddle Avenue
Wyandotte, Michigan

SURFACE ELEV.

DATE 7-10-96

Sample & Type	Depth	Legend	Soil Description	Penetration Blows For 6"	Moisture %	Natural Wt. P.C.F.	Dry Den Wt. P.C.F.	Unc. Comp. Strength PSF.	Str. %
A			0'2" Moist brown GRAVEL	13					
SS	1		0'7" Extremely stiff moist dark brown sandy CLAY, fill	13					
			1'2" Extremely compact moist brown fine to medium SAND, fill	17					
	2			20					
B			2'4" Extremely compact moist dark brown mixed SLAG & fine to medium SAND with gravel and clay, fill	10					
SS	3		3'0" Extremely compact moist gray silty sandy CRUSHED LIME-STONE, fill	27					
				31					
	4		4'0" Extremley compact moist dis-colored gray to white clayey SAND with gravel (possible brite sorb), fill	11					
	5								
	6								
	7								
	8								
	9								
	10								
	11								
	12								
	13								
	14								
	15								
	16								
	17								
	18								
	19								
	20								
	21								
	22								
	23								
	24								
	25								

TYPE OF SAMPLE
D. - DISTURBED
U.L. - UNDIST. LINER
S.T. - SHELBY TUBE
S.S. - SPLIT SPOON
R.C. - ROCK CORE
( ) - PENETROMETER

REMARKS:

Standard Penetration Test - Driving 2" OD Sampler 1' With 140# Hammer Falling 30"; Count Made At 6" Intervals

GROUND WATER OBSERVATIONS

G.W. ENCOUNTERED AT		FT.	INS.
G.W. ENCOUNTERED AT		FT.	INS.
G.W. AFTER COMPLETION		FT.	INS.
G.W. AFTER	HRS.	FT.	INS.
G.W. VOLUMES			

LOG OF SOIL BORING NO. 20

McDOWELL & ASSOCIATES
Geotechnical Engineers

PROJECT BASF

JOB NO. 96-359

LOCATION 1609 Biddle Avenue

SURFACE ELEV.

DATE 7-10-96

Wyandotte, Michigan

	Depth	Legend		SOIL DESCRIPTION	Penetration Blows For 6"	Moisture %	Natural Wt. P.C.F.	Dry Den Wt. P.C.F.	Unc. Comp. Strength PSF.	Str. %
A			0'3"	Moist brown GRAVEL, fill	3					
SS	1		1'0"	Medium compact moist mixed	3					
				black and dark brown fine	5					
	2			to medium SAND with gravel	10					
B				and trace of clay, fill	9					
SS	3			Compact to very moist moist	12					
				to wet black SLAG & SAND	10					
	4		4'0"	with gravel, fill	12					
	5									
	6									
	7									
	8									
	9									
	10									
	11									
	12									
	13									
	14									
	15									
	16									
	17									
	18									
	19									
	20									
	21									
	22									
	23									
	24									
	25									

TYPE OF SAMPLE
D. - DISTURBED
U.L. - UNDIST. LINER
S.T. - SHELBY TUBE
S.S. - SPLIT SPOON
R.C. - ROCK CORE
( ) - PENETROMETER

REMARKS:

Standard Penetration Test - Driving 2" OD Sampler 1' With 140# Hammer Falling 30"; Count Made At 6" Intervals

GROUND WATER OBSERVATIONS

G.W. ENCOUNTERED AT 2 FT. 0 INS.
G.W. ENCOUNTERED AT FT. INS.
G.W. AFTER COMPLETION 1 FT. 0 INS.
G.W. AFTER HRS. FT. INS.
G.W. VOLUMES heavy

LOG OF SOIL BORING NO. 21

McDOWELL & ASSOCIATES
Geotechnical Engineers

PROJECT BASF

JOB NO. 96-359

LOCATION 1609 Biddle Avenue
Wyandotte, Michigan

SURFACE ELEV.

DATE 7-10-96

Sample Type	Depth	SOIL DESCRIPTION	Penetration Blows For 6"	Moisture %	Natural Wt. P.C.F.	Dry Den Wt. P.C.F.	Unc. Comp. Strength PSF.	Str. %
A SS	0'3"	Moist brown GRAVEL, fill	3					
	1'0"	Compact moist discolored brown silty fine SAND with gravel and clay, fill	2					
			42					
	2'0"	Extremely compact moist discolored gray clayey SAND with some gravel and pebbles (possible brite sorb), fill	21					
B SS			32					
			8					
	3'8"	Very compact wet black SLAG with sand and pebbles, fill	10					
	4'0"	Extremely compact wet discolored greenish-brown silty fine SAND with trace of clay, fill	16					

TYPE OF SAMPLE
D. - DISTURBED
U.L. - UNDIST. LINER
S.T. - SHELBY TUBE
S.S. - SPLIT SPOON
R.C. - ROCK CORE
( ) - PENETROMETER

REMARKS:

Standard Penetration Test - Driving 2" OD Sampler 1' With 140# Hammer Falling 30"; Count Made At 6" Intervals

GROUND WATER OBSERVATIONS

G.W. ENCOUNTERED AT		2 FT.	0 INS.		
G.W. ENCOUNTERED AT		FT.	INS.		
G.W. AFTER COMPLETION		2 FT.	0 INS.		
G.W. AFTER	HRS.	FT.	INS.		
G.W. VOLUMES	heavy				

LOG OF SOIL BORING NO. 22

McDOWELL & ASSOCIATES
Geotechnical Engineers

PROJECT BASF

JOB NO. 96-359

LOCATION 1609 Biddle Avenue
Wyandotte, Michigan

SURFACE ELEV.

DATE 7-10-96

Sample Type	Depth	Legend	SOIL DESCRIPTION	Penetration Blows For 6"	Moisture %	Natural Wt. P.C.F.	Dry Den Wt. P.C.F.	Unc. Comp. Strength PSF.	Str. %
A			0'2" Moist brown GRAVEL, fill	5					
SS	1		Compact moist discolored brown to black silty fine to medium SAND with pebbles, gravel and wood, fill	6					
				5					
	2		2'0"	6					
B				5					
SS	3		Compact wet black fine to medium SAND & GRAVEL with slag and bricks, fill	6					
				5					
	4		4'0"	7					
	5								
	6								
	7								
	8								
	9								
	10								
	11								
	12								
	13								
	14								
	15								
	16								
	17								
	18								
	19								
	20								
	21								
	22								
	23								
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TYPE OF SAMPLE
D. - DISTURBED
U.L. - UNDIST. LINER
S.T. - SHELBY TUBE
S.S. - SPLIT SPOON
R.C. - ROCK CORE
( ) - PENETROMETER

REMARKS:

Standard Penetration Test - Driving 2" OD Sampler 1' With 140# Hammer Falling 30"; Count Made At 6" Intervals

GROUND WATER OBSERVATIONS

G.W. ENCOUNTERED AT	2 FT.	0 INS.		
G.W. ENCOUNTERED AT	FT.	INS.		
G.W. AFTER COMPLETION	2 FT.	0 INS.		
G.W. AFTER	HRS.	FT.	INS.	
G.W. VOLUMES	heavy			